Typed/Printed version of Petition for Revival

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U.S. Patent and Trademark Office; U.S. DEPARTMENT FCOMMERCE
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PETITION FOR REVIVAL OF AN APPLICATION FOR PATENT ABANDONED UNAVOIDABLY UNDER 37 CFR 1.137(a)

Docket Number (Optional)

First named inventor: Lowell S. Fink

Group Art Unit: 3617

Application Number: 09/781,167

Examiner: Edwin L. Swinehart

Filed: February 13, 2001

Title: Semi-Elliptical Sail System for Wind Propelled Vehicles

Attention: Office of Petitions
Assistant Commissioner for Patents
Box DAC
Washington, D.C. 20231

NOTE: If information or assistance is needed in completing this form, please contact Petitions Information at (703) 305-9282.

The above-identified application became abandoned for failure to file a timely and proper reply to a notice or action by the United States Patent and Trademark Office. The date of abandonment is the day after the expiration date of the period set for reply in the Office notice or action plus any extensions of time actually obtained.

APPLICANT HEREBY PETITIONS FOR REVIVAL OF THIS APPLICATION
NOTE: A grantable petition requires the following items:
(1) Petition fee;
(2) Reply and/or issue fee;
(3) Terminal disclaimer with disclaimer fee--required for all utility and plant applications filed before June 8, 1995, and for all design applications; and
(4) Adequate showing of the cause of unavoidable delay

1. Petition fee

[X] small entity - fee $ 55 (37 CFR 1.17(l)). Applicant claims small entity status. See CFR 1.27.

other than small entity - fee $________(37 CFR 1.17(l)).

2. Reply and/or fee

A. The reply and/or fee to the above-noted Office action in the form of amended Application: "Amendment A" (identify the type of reply):

has been filed previously on____________________________.
[X] is enclosed herewith.

B. The issue fee of $_____
has been paid previously on____________________________.
is enclosed herewith.

Burden hour Statement: This form is estimated to take 1.0 hours to complete. Time will vary depending on the needs of the individual case. Any comments on the amount of time you are required to complete this form should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, Washington, DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Assistant Commissioner for Patents, Washington, D.C. 20231.

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PETITION FOR REVIVAL OF AN APPLICATION FOR PATENT ABANDONED UNAVOIDABLY UNDER 37 CFR 1.137(a)

3. Terminal disclaimer with disclaimer fee
   Since this utility/plant application was filed on or after June 8, 1995, no terminal disclaimer is required.

   A terminal disclaimer (and disclaimer fee (37 CFR 1.20(d)) of $________for a small entity of $_____ for other than a small entity) disclaiming the required period of time is enclosed herewith (see PTO/SB/63).

4. An adequate showing of the cause of the delay, and that the entire delay in filing the required reply from the due date for the reply until the filing of a grantable petition under 37 CFR 1.137(a) was unavoidable, is enclosed.

WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

May 5, 2003
Date

Signature

Telephone
Number: (011 33) 493019616

Email: ffinklow@aol.com

Lowell S. Fink
Typed or printed name

787Ch. Fontaine du Canet
Villefranche sur Mer 06230 France
Address

Enclosures: [X] Fee Payment

[X] Reply

Terminal Disclaimer Form

[X] Additional sheets containing statements establishing unavoidable delay
8 sheets

CERTIFICATE OF MAILING OR TRANSMISSION [37 CFR 1.8(a)]

I hereby certify that this correspondence is being:

[X] deposited with Fedex on the date shown below with sufficient payment in an envelope addressed to: Assistant Commissioner for Patents, Box DAC, * ~~Washington, D.C. 20231.~~

transmitted by facsimile on the date shown below to the United States Patent and Trademark Office at (703) 308-6916.

5/14/03
Date

Signature

Lowell S. Fink
Typed or printed name of person signing certificate

* 2201 S. Clark Place
Crystal Plaza 4
Room 3C23
Arlington, Va.
22202 USA
Tel: 703-3059282

PTO/SB/61 (10-00)
Approved for use through 10/31/2002. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

PETITION FOR REVIVAL OF AN APPLICATION FOR PATENT ABANDONED UNAVOIDABLY UNDER 37 CFR 1.137(a)

NOTE: The following showing of the cause of unavoidable delay must be signed by all applicants or by any other party who is presenting statements concerning the cause of delay.

May 5, 2003
Date

Signature

Lowell S. Fink

Typed or printed name

(In the space provided below, please explain in detail the reasons for the delay in filing a proper reply)

See Petitioner's separate 8-page Declaration of Unavoidable Delay and supporting Attachments:

1. Amendment A to original Application
2. Response to First Office Action
3. Copy of cover page of First Office Action with Petitioner's note of Extension fees
4. Petitioner's 10/13/02 Request for Change of Address
5. Petitioner's 12/02/02 request for Extension and Change of Address
6. Petitioner's 4/23/03 email to the Examiner
7. Examiner's 4/23/03 response to Petitioner's email of same date
8. Bulletin d'Hospitalization, Clinique St. Antoine: 04/-9-15/2002
9. Petitioner's 10/10/02 request for copies to be sent to French address

(Please attach additional sheets it additional space is necessary)

PETITION FOR REVIVAL OF AN APPLICATION FOR PATENT ABANDONED UNAVOIDABLY UNDER 37 CFR 1.137(a)

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May 5, 2003
Date

Signature

Lowell S. Fink
Typed or printed name

Telephone Number: (011) 33 493019616

Email: ffinklow@aol.com

787 Ch. Fontaine du Canet
Address
Villefranche-Sur-mer
06230 FRANCE

Enclosures: ☑ Fee Payment

☑ Reply

☐ Terminal Disclaimer Form

☑ Additional sheets containing statements establishing unavoidable delay

☑ 8 Sheets

CERTIFICATE OF MAILING OR TRANSMISSION [37 CFR 1.8(a)]

I hereby certify that this correspondence is being:

☑ deposited with ~~the United States Postal Service~~ FEDEX on the date shown below with sufficient postage as first class mail in an envelope addressed to: Assistant Commissioner for Patents, Box DAC, ~~Washington, D.C. 20231~~. *

☐ transmitted by facsimile on the date shown below to the United States Patent and Trademark Office at (703) 308-6916.

5/14/03
Date

Signature

LOWELL S. FINK
Typed or printed name of person signing certificate

* 2201 S. Clark Place
Crystal Plaza 4
Room 3C23 (Box DAC)
Arlington, Va. 22202 USA
Tel: 703-3059282

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PETITION FOR REVIVAL OF AN APPLICATION FOR PATENT ABANDONED UNAVOIDABLY UNDER 37 CFR 1.137(a)

NOTE: The following showing of the cause of unavoidable delay must be signed by all applicants or by any other party who is presenting statements concerning the cause of delay.

5/5/03
Date

[signature]
Signature

Lowell S. Fink
Typed or printed name

(In the space provided below, please explain in detail the reasons for the delay in filing a proper reply)

See attached Declaration and Document from S.A. Clinique St. Antoine, along with other 8 supporting Documents, altogether comprising Attachments 1-9 and the underlying Declaration.

1. Petitioner's Amendment A
2. Response to first office Action
3. copy of cover page of first office Action
4. Petitioner's 10/13/02 Request change address
5. Petitioner's 12/07/02 Request for Extension
6. Petitioner's 4/23/03 email to Examiner

(*Please attach additional sheets it additional space is necessary*)

7. Examiner's 4/23/03 Email to Petitioner
8. Bulletin d'Hospitalisation - Clinique St. Antoine
9. Petitioner's 10/10/02 Request for copies to be send to French address.

In the United States Patent and Trademark Office

Serial Number: 09/781,167
Appn. Filed: February 13, 2001
Applicant: Lowell S. Fink
Appn. Title: Semi-Elliptical Sail System for Wind-Propelled Vehicles
Examiner/GAU Edwin L.Swinehart/3617

Declaration of Unavoidable Delay in Response to a First Office Action pursuant to 37 C.F.R. 1.1 7(a)

Assistant Commissioner for Patents
Washington, District of Columbia 20231

Sir: Petitioner's Petition to Revive with Supplementary Declaration pages along with Attachments 1-8 are hereby submitted to support revival of the above Application.

Attachments:
1. Amendment A to original Application
2. Response to First Office Action
3. Copy of cover page of First Office Action with Petitioner's note of Extension fees
4. Petitioner's 10/13/02 Request for Change of Address
5. Petitioner's 12/02/02 request for Extension and Change of Address
6. Petitioner's 4/23/03 email to the Examiner
7. Examiner's 4/23/03 response to Petitioner's email of same date
8. Bulletin d'Hospitalization, Clinique St. Antoine: 04/-9-15/2002
9. Petitioner's 10/10/02 request for copies to be sent to French address

Lowell S. Fink, the undersigned, (hereinafter Petitioner) declares as follows:

I am the Applicant in the above Application and have firsthand knowledge of the facts contained herein. A chronological summary of those facts follows:

1, **September 13, 2002**:

A. An Office Action (hereinafter "First Office Action") dated 09/09/02 and mailed **09\13\02** objected to Petitioner's Application as elected/restricted, serial no. 09/781,167, and allowed three months, or until 12/13/02 to respond.

B. Substituted Specification, Drawings, and Claims required:

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OFFICE OF PETITIONS

Petitioner would eventually replace the original Application having an 88-page Specification and 15 Drawing pages with Amendment A having a 123-page substitute Specification and 11 substitute Drawing pages. (Attachment 1) Petitioner would also prepare a 43-page Response to specific Objections of the First Office Action (Attachment 2). Only Substitution could satisfy the objections of the First Office Action:

The original Application was drawn to sail configurations that grouped hoisted and furled sails together. It was not possible to isolate the elected, hoisted-sail-elements of the original application from the non-elected furled-sail-elements by lining out parts of the Specification or by partially modifying the original Drawings. Therefore, Petitioner was obliged to prepare entire substituted Specification, Drawings and Claims.

2. October 15, 2002

A. Petitioner returned from a two-month sail prototyping trip around Corsica and Sardinia on 10/10/02, unaware that an Office Action requiring timely response had been mailed to his Houston, Tx. address while he was at sea.

B. On **10/15/02** Petitioner received by fax a forwarded copy of The First Office Action, which had been mailed to Petitioner's Houston, Tx. address while Petitioner was at sea.

C. Thus, Petitioner became aware of the First Office Action approximately one month after it was mailed. Even if Petitioner had been aware of the First Office Action earlier, he would have been unable to begin work on a Response until returning from the sail prototyping trip. In this context, Petitioner realized that he had only two months to complete his Response.

3. November 27, 2002:

A. By **11/27/02**, Petitioner recognized that mailing a Response by the 12/13/02 Response deadline set by the First Office Action would significantly compromise the quality of the Response.

B. Consequently, Petitioner called the USPTO concerning the possibility of an Extension of time to respond. Ms. Lashonnah Tyson took Petitioner's Application information.

C. Ms. Tyson advised Petitioner that extensions of time ranging from one to five months could attach to response dates set by an Office Action, and that fees of $55, $200 and $460, respectively, applied to Extension periods of increasing length.

D. Petitioner was advised specifically that:

1) Should Petitioner require additional Extension/s, such extension/s would be effective <u>without separate application or other action on his part.</u>

2) Once an initial Extension request and payment had been made, Petitioner could pay any additional Extension fees according to the actual filing date of his Response; and

3) Extension periods ran from the date for Response set by Office Action.

E. Petitioner made a note of Ms. Tyson's name and the Extension fee information she gave him on his copy of the First Office Action (attachment 3).

F. At no time was did Ms. Tyson advise Petitioner that the maximum extension he could obtain was a three-month extension ending 03/13/2003. Rather, she quoted a $460 cost for a period terminating **<u>after</u>** the maximum allowable time for response would expire. Petitioner was not aware of any such limitation until after the allowable period had expired.

G. **At no time was Petitioner instructed to contact the Examiner concerning a request for Extension or Extension fees.**

H. At no time prior to 04/23/03 did Petitioner have any reason to question Ms. Tyson's advice; nor did Petitioner have any reason to contact the Examiner. Furthermore, Petitioner wished to reserve allowable contact with the Examiner to address any potential substantive questions that might arise following the filing of Petitioner's Response.

3. **December 2, 2002: DELAY WAS ALREADY UNAVOIDABLE**

A. The information provided to Petitioner by Ms. Tyson on 11/27/02 led him to set a May 1, 2003 target date for completing his Response and amended Application date. That personal target date allowed nearly two weeks to resolve any unforeseen drafting problems.

A. USPTO advice that Extension/s would date from the 12/13/02 response date set by the First Office Action had already put in motion an **unavoidable** sequence of events.

B. On **12/02/02**, pursuant to the information Ms. Tyson had provided to him, Petitioner sent by fax a request for Extension and authorized credit-card payment for a one-month Extension.

1) Petitioner directed the communication to the Examiner with copy to Ms. Tyson to confirm that Petitioner was diligently prosecuting his Application and would require Extension/s of time to respond.

2) In that same communication, Petitioner requested that USPTO **change his mailing address** from one in Texas to one in France.

3) As seen in "10" below, Petitioner has reason to believe that his faxed request for Extension and his requests for Change of Address were either not received or not acted upon by USPTO (See attachments 4 and 5).

4) Petitioner continued working full-time on his Response in an attempt to complete and file it at the earliest possible moment, at the latest, in advance of his personal May 1, 2003 target date and the 05/13/03 deadline based on USPTO-furnished information.

5) Petitioner relied on the advice Ms. Tyson gave him, diligently preparing his Response and amended Application, completing it in late April, 2003. Thus, Petitioner was ready to mail his Response in advance of his May 1, 2003 target date and, above all, well in advance of the 05/13/03 deadline based on USPTO-furnished information.

6) At a minimum, Petitioner submits that a constructive deadline of 05/13/03 should be applied in the circumstances, and that such constructive deadline should lead to a granting of the present Petition for Revival.

7) At no time did Petitioner have any reason to question Ms. Tyson's advice or to contact the Examiner concerning Extension or any other matter. At

all times Petitioner diligently and on a full-time basis pursued his Application. Petitioner submits that bona fide and diligent prosecution of his Application precludes any inference of either inattention or an intent to abandon.

4. <u>April 7, 2003: INTERVENING EMERGENCY SURGERY</u>

1. On **04/07/03**, Petitioner's wife began complaining of severe abdominal pains. On 04/09/03, she was ultimately diagnosed as having an acute appendicitis/peritonitis. Immediately upon diagnosis she underwent **emergency surgery.**

2. But for this series of events, Petitioner would have completed his Response and requested the amount of Extension fee due well in advance of the eventual late-April 2003 mailing of a Notice of abandonment.

3. From April 7, 2003, when the medical problems of Petitioners' wife began, until the present date, Petitioner has been occupied with taking his wife to the emergency room, visiting her in the hospital, eventually bringing her home and caring for her. Necessarily, this further delayed preparation of the present Petition to Revive and the mailing of Petitioner's Response and amended Application.

4. An original of the hospital record documenting Mrs. Fink's 09/06/03 entry and 09/15/03 release from hospital is attached (attachment 8).

5. <u>April 23, 2003:</u>

A. By April 22, 2003, ten days **before** his personal target mailing date, Petitioner was ready to mail his Response and amended Application. Petitioner called the USPTO for the exact amount of the fee that should accompany his mailing. **He was first transferred to the Fee Section, which advised him that it would be necessary to contact the Examiner for the amount of the fee that would be due.**

B. Petitioner called the Examiner, who was not available to the telephone. Petitioner left a recorded message and confirmed it in an email to the Examiner (attachment 6).

C. The Examiner promptly responded to Petitioner's inquiry by email dated **04/23/03**, stating that the latest date for Petitioner's Response had passed on 03/13/03, and that a Notice of Abandonment had been mailed the preceding day (attachment 7).

6. April 24, 2003:

A. In a telephone conversation the following day, the Examiner, Mr. Swinehart advised Petitioner that although the Notice of Abandonment was a nonfinal action, he no longer had the power to allow a Response.

B. The Examiner further advised Petitioner that he would have to file a Petition to Revive if he wished to continue prosecuting his Application.

7. April 2003 v. December 2002: CONTRASTING USPTO ADVICE

A. In **April 2003** the USPTO fee section referred Petitioner to the Examiner for all information concerning Extension and Extension fees. Petitioner respectfully submits that had Ms. Tyson acted identically in **December 2002**, the present problem would not have arisen.

B. The same USPTO procedures or policies that caused the Fee Section to instruct Petitioner to contact the Examiner in March 2003 were, in all likelihood, in effect at the time of Petitioner's earlier December 2002 contact with Ms.Tyson.

C. Certainly, had Ms. Tyson directed Petitioner to the Examiner in December 2002, the Examiner would have advised Petitioner of the absolute 03/13/03 deadline for responding to the First Office Action.

D. In such event, the present question would never have arisen; no Notice of Abandonment would ever have been sent; and Petitioner could have taken appropriate and timely measures to maintain his Application in a fully active status.

8. AFFIRMATION OF UNINTERRUPTED DILIGENT PROSECUTION OF APPLICATION

Within the context of a 05/13/03 deadline based on USPTO-furnished information, Petitioner made every possible effort to complete and file his Response and amended Application at the earliest possible moment.

9. USPTO POLICY FAVORS PRESERVATION OF APPLICANT RIGHTS

USPTO policy favors preserving Applicant rights and avoiding unnecessary administrative action. Petitioner submits that the present delay was unavoidable for the reasons set forth above, and that in light of USPTO policy, the present Petition should be granted.

10. PETITIONER'S REQUEST FOR EXTENSION AND REQUESTS FOR CHANGE OF ADDRESS WERE NOT PUT INTO EFFECT:

A. The abovementioned Notice of Abandonment was mailed to Petitioner's **Houston, Tx. address** despite two requests by Petitioner that his address be changed to one in France. Petitioner had sent a first request for Change of Address by fax with hard copy by mail on 10/13/02 (Attachment 4).

B. Petitioner repeated his request for Change of Address on 12/02/02 in his faxed request for Extension and Change of Address (Attachment 5.).

C. Apparently neither Petitioner's 10/13/02 request for Change of Address nor his 12/02/02 request for Extension and Change of Address were acted upon by USPTO.

D. Petitioner's repeated requests for Change of Address and his request for Extension were bona fide efforts to receive USPTO communications as quickly as possible in order to make complete and timely responses to all such communications. Petitioner had no control over USPTO's handling of those requests once he had sent them.

E. Had USPTO confirmed to Petitioner, as requested, that his12/02/02 request for Extension and Change of Address had been received, USPTO's form of response might have alerted Petitioner to a six-month maximum time for response. Petitioner submits that USPTO's omission in confirming receipt of that request contributed to making Petitioner's delay in response unavoidable.

F. At a minimum, USPTO's continuation of Petitioner's Houston, Tx. mailing address illustrates a breakdown in communication despite Petitioner's bona fide efforts to expedite communication with USPTO. Consequent and considerable delay in receipt of USPTO communications is evidenced by the month-long delay in actual receipt of the First Office Action and by the ten-day delay in receipt of the Notice of Abandonment.

G. Pursuant to an October 10, 2002 fax request (attachment 9), USPTO did send certified copies of Petitioner's Application to his French address.

This evidences a lack of consistency between different sections of USPTO in communicating with Petitioner at his designated French address.

H. Petitioner had every reason to believe that USPTO was processing his application using his Houston, Tx. address once he received the requested certified copies at his French address,

11. REQUEST FOR RELIEF

Petitioner's check in the amount of $55 is attached as the fee for revival of Application No. 09/781,167. In view of the sequence of events summarized above, and for the reasons stated herein, as affirmed by attached supporting documents, Petitioner respectfully requests the Revival of the present cause and the acceptance for Examination of: the attached Response and Amended Application, and that Notice of abandonment be vacated.

Petitioner submits that the foregoing establishes an adequate showing of the cause of the delay, and that the entire delay in filing the required reply from the due date for the reply until the filing of a grantable petition under 37 C.F.R. 1.137(a) was unavoidable.

Respectfully Submitted,

5/5/02

Lowell S. Fink

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Serial Number: 09/781,167; Priority Filing date 2/13/2001 Provisional Patent Application Ser. #60/182207

Appn. Filed: 2/14/2000

Applicant: Lowell S. Fink

Appn. Title: "Universally Compatible, Semi Elliptical, Vertically Deployed Sail System for Wind - Propelled Vehicles"

Examiner/GAU: Ed L. Swinehart, Art Unit 3617

Amendment A

CROSS REFERENCE TO RELATED APPLICATIONS

Filing Date 2/14/2000 and United States Patent Application Ser. # 09/781,167 Priority Filing date 2/13/2001.

BACKGROUND – FIELD OF INVENTION

This invention relates to a System of hoisted sails compatible with any wind-propelled vehicle, specifically, a System comprising semi-elliptical hoisted sails and means for their deployment and control.

BACKGROUND – OVERVIEW OF THE PRIOR ART

PERFORMANCE VERSUS CONVENIENCE AND SAFETY PROIORITIES: 1925 TO DATE

Until 1975, sailmakers primarily marketed sail performance or sail durability. Technology for convenient sail handling was still in the future, and easy-to-use high-performance sails were unimaginable. In 1975, truly functional convenience and safety-oriented sail handling technology began to appear, promising to make sailing easier and safer but imposing significant performance compromises.

Notwithstanding inevitable performance compromises, boat owners and new boat buyers increasingly opted for easily controlled, or "convenient" sails. Sail design dictum inescapably cast optimum sail performance and optimum sail handling convenience as irreconcilable adversaries.

AN ONGOING GEOMETRIC PROHIBITION OF EFFICIENT SAIL DESIGN

A 1925 discovery revealed that triangular sail form was the least efficient form possible, and that elliptical sail form was the most efficient form possible. Unfortunately, conventional sailboat rig geometry would impede application of that discovery to the sails of conventionally rigged sailboats, underscoring a basic and tenacious gap between sail design theory and sail design feasibility.

A side view of any conventionally rigged sailboat shows a mast supported by forward and aft rigging wires, forming fore and aft rig triangles. Sail designers quite naturally, and invariably have respected those rig triangles as absolute limitations on the perimeter of a mainsail or a self-tacking headsail, each of which connects to a sailboat **inside** a corresponding rig triangle. Necessarily, designers drew sails controlled by a single sheet as or smaller, or "inner" triangles limited by companion rig elements. Notably, a boat's mast limited the profile of its self-tacking jib, and a boat's permanent backstay limited the profile of its mainsail.

Designers accepted that:

1. optimum sail handling convenience and optimum sail performance were irreconcilable; and also that
2. sails controlled by a single-sheet, **self-tacking sails,** must not overlap any rig element if such sails were to have the ability to tack and jibe through the axis of the wind.

Simply stated, designers felt that a sail that touched a rig element could never tack and jibe safely and reliably.

Sail designers never speculated on whether an overlapping, self -tacking sail was even theoretically feasible, or whether such a sail could reconcile optimum performance and convenience. To the contrary, designers simply assumed that optimum sailboat performance and optimum convenience were irreconcilable, and that a functional sail couldn't contact rig elements.

No designer imagined that a sail controlled by a single sheet could tack and jibe safely and reliably if its back end had to cross an intervening mast or permanent backstay. Designers assumed that the sail would "hang up" and eventually self-destroy. That assumption was to profoundly obstruct advances in the art of sail design and fabrication. For ease of reference, a reference calender attaches to the following detailed review of prior art.

Ideally, any boat's helmsman, unassisted by crew, would be able to maintain optimum boat speed in all conditions and, without assistance, turning through the wind as easily as one drives a car. That ideal has remained unattainable.. To meet changing conditions, boat owners must still buy diverse inventories of headsails, each controlled by separate port and starboard sheets; each yielding a level of performance proportional to sail cost and the crew effort and risk required to use then. <u>No available sail system has ever minimized cost, effort, and risk while providing optimum sailboat performance</u>.

<u>SAIL MAKING TERMINOLOGY</u>

The text of the present cause, **"the text"** describes Applicant's sail system, the **"System"** with terminology known to one skilled in the art. In that context, a "**conventionally rigged"** sailboat is one having a mast supported by **"standing rigging"** consisting of: forward, lateral and aft rigging wires: **a "permanent forestay";** port and starboard **"shrouds";** and a **"permanent backstay"**, respectively. Collectively, the mast and supporting wires are referred to as **"rig elements"**. Detailed terminology for describing a boat's sails and sail control systems follow:

1. The upper, forward and aft corners of a sail are its **"head"**, **"tack"**, and **"clew"**, respectively. The leading, trailing, and bottom edges of a sail are its **"luff"**, **"leech"**, and **"foot"**, respectively. A semi-elliptical sail's **"roach"** area is an aft extension of the sail's triangular area lying between the sail's head-to-clew line and its leech.

2. In contrast to the linear leech of a triangular sail, the leech of a **"semi-elliptical"** sail is a <u>convex</u> curve.

3. Forward sails, or **"headsails"** are controlled either by a single **"self-tacking"** sheet that requires no crew intervention, or by separate port and starboard sheets that crew must alternately tension and release.

4. A Mainsail systematically connects to a mast along its luff. A mainsail's foot typically connects to a rigid external boom controlled by a single self-tacking sheet.

5. A headsail systematically connects along its luff to a forestay. A headsail could be controlled by a single self-tacking sheet if its leech did not overlap its companion mast. If headsail did overlap its companion mast, it required separate, alternately tensioned port and starboard sheets.

6. Typically, sail construction involved **woven** or **laminated** sailcloth cut into panels and assembled by sewing or gluing. Recently, sailmakers introduced sails that employed proprietary **fiber-oriented laminating technology**, whereby individual fibers are laminated in specific orientation and density between layers of synthetic film, often with abrasion resistant outer layers. North 3-D ™, UK Tape Drive™, and Sobstad Genesis™ exemplify the latter type of sail construction.

7. **Battens** have long been used to stabilize a sail's leech. By 1980, easily broken, heavy wooden battens had been replaced by durable, semi-rigid fiberglass battens.

8. A diagonal **"vang"** tackle or solid strut connects a rigid boom to a boat's deck, thus resisting the tendency of a sail's clew to rise as a boat turns away from the wind.

9. **"Standing sails"** connect along their luff edge to a boat's forestay in the case of a headsail, and to its mast in the case of a mainsail.

10. The **"working sails"** of a conventionally rigged sailboat consist of a non-overlapping headsail, or "working jib" and a mainsail.

11. A **"free-flying headsail"** can use elliptical form because it sets <u>outside</u> a boat's rigging, usually ahead of its forestay, as in the case of a spinnaker. Connected to the boat only at three corners, a free flying headsail must be hoisted and lowered as conditions change or a boat turns through the wind. Such sails typically require crew to set and strike a lateral supporting pole as conditions and boat course change. Free flying headsails are crew intensive, and even with skilled crew such sails are frequently dangerous to use.

12. Foot length of headsails is generally expressed as a percentage of **"j"**, which is forestay-to-mast distance at deck level. Thus, a 100% jib, or conventional **"working jib"** is **"non-overlapping."** A headsail whose foot length exceeds "j" is generally referred to as an **"overlapping headsail", or "genoa"** because its clew overlaps a boat's mast.

13. A mainsail whose aft end does not contact a boat's **"permanent backstay"** is a **"non-overlapping mainsail"**.

MOST EXISTING SAILBOATS USE ONLY TWO SAILS: 1925 TO DATE

At least ninety-percent of contemporary sailboats are **"conventionally rigged",** having a mast supported by forward, lateral, and aft rigging wires: a forestay, lateral shrouds, and a backstay, respectively. For cost and convenience reasons, most conventionally rigged sailboats use only two sails, known as **"working sails"**, which consist of:

1. Forward, a **headsail** hoisted by a halyard; attached along its leading edge to a forestay; and attached at its aft corner, or "clew" either to alternately tensioned port and starboard sheets, or to a single self-tacking sheet. Conventional self-tacking, non-overlapping headsails may also connect to a rigid external jib spar controlled by a single self-tacking sheet in which case the rigid spar holds the jib's foot in horizontal extension.

2. Aft, a **mainsail** hoisted by a halyard, attached along its leading edge to a boat's mast; and attached along its foot to a rigid external spar controlled by a single self-tacking sheet.

Sails controlled by a single self-tacking sheet eliminate the need for crew to alternately release and tension port and starboard sheets, thus allowing a helmsman to turn a boat as easily as a driver turns an automobile. Despite their convenience, hoisted, triangular self-tacking jibs lost popularity as post-1980 sailors regularly chose larger, overlapping triangular **roller-furling** sails that could be deployed and recovered from the safety of the cockpit. On-deck sail handling imposed by hoisted sails quickly became unacceptable to a majority of sailors.

Thus did the hoisted self-tacking sail lose market share to heavier, more costly roller furling configurations, which also compromised performance. After an early rush to roller furling

configurations, sailors would reevaluate the convenience-oriented-trend to long-footed overlapping furling genoas. The real versatility and convenience of such sails eventually belied sailmakers' promotional sales rhetoric.

TRIANGULAR WORKING SAILS

In theory, the worst possible two-dimensional sail profile is triangular, and the best two-dimensional sail profile is elliptical. In practice, triangular **"working"** sails remain predominant, and theoretically superior elliptical working sails remain theoretical. This anomaly is explained below:

1. Since a boat's non-overlapping working sails had invariably set **inside** the confines of a boat's rigging wires, or "rig triangles", designers assumed that the profile of working sails must replicate the triangular profile of a boat's rig geometry without overlapping companion rig triangles.
2. On the other hand, supplementary free flying sails set **outside** a boat's rigging, thus avoiding contact with rig elements. Consequently, designers felt free to use elliptical profiles for such sails. However, free flying sails required costly supplemental equipment and a complement of skilled athletic crewmembers. Useful only in limited downwind situations, free flying sails addressed performance priorities while ignoring convenience and safety entirely.
3. **Optimum performance** still requires a costly, cumbersome variety of inconvenient hoisted triangular headsails and elliptical free flying headsails controlled by alternately tensioned port and starboard sheets.
4. **Optimum convenience** appears to favor roller-furling sails, but potential mechanical problems plus the limited versatility of such sails in varying conditions qualifies their apparent convenience.
5. **Optimum convenience** could favor hoisted self-tacking sails but for their small, inefficient triangular profile; their need for a cumbersome external spar for effective downwind use, and the fact that hoisted jibs could not be safely deployed, reefed, or recovered in all conditions from the safety of a boat's cockpit. Hoisted mainsails have become easier to use, but hoisted jibs have not, leading to a severe loss in headsail market share.

6. Thus, hoisted sails have given way to easily deployed furling sail configurations. As concerns headsails, a fully deployed overlapping furling headsail has more sail area than a hoisted non-overlapping working jib. However, a furling configuration costs more than a hoisted one, adds weight aloft, and is less efficient for heavier conditions when partially furled.

7. In summary, contemporary sailmakers are able to deliver performance or "convenience and safety", but not in the same package.

WHAT HAS CHANGED: 1925 TO DATE

Sail deployment, reefing and recovery as well as saildoth and sail construction methods have advanced markedly along with the three-dimensional aspect of sails.

WHAT HAS NOT CHANGED: 1925 TO DATE

Theoretically, **"Semi-elliptical"** working sails having an elliptical trailing edge, or **"leech"** produce optimum sail area and optimum efficiency. Such working sails have never been reduced to practice due to the persistence of prevailing design assumptions. The persistent and seemingly inevitable triangular profile of today's working sails imposes three major design barriers:

A. The sail area of a mainsail is still limited by its companion permanent backstay;

B. The sail area of a working jib is still limited by its companion mast and lateral rigging; and

C. A rigid external spar is still indispensable for maintaining tension along the foot of a working sail in all wind and sea conditions. Such spars pose a danger to crewmembers and, in the case of a jib, obstruct access to a boat's foredeck anchor stowage locker.

CONFLICTING PRIORITIES: 1980 TO DATE

By 1980 sailmakers were celebrating the introduction of furling sails that satisfied both performance and convenience priorities. As seen below, sailmakers' claims differed materially from the demands imposed by actual sailing conditions.

1. Maximum boat speed across a wide range of conditions had always required a maximum number of sails and a maximum number of skilled, athletic crewmembers willing to perform dangerous on-deck sail maneuvers regardless of wind and sea conditions. Such is still the case.

2. At the opposite extreme, "multi-purpose" furling sails delivered maximum convenience and safety but compromised windward ability and maximum boat speed by ten to twenty percent.

THE PRESENT STATE OF THE ART: BOAT OWNER PRIORITIES IN DETAIL

At one extreme, convenience and safety-oriented boat owners accepted only easy to use cockpit-controlled roller-furling sails. Boat speed was secondary. At the other extreme, the owner's controlling priority, boat speed, required large skilled crews to perform dangerous on-deck sail handling maneuvers. Convenience and safety were a lower priority.

On balance, boat owners today increasingly seek convenience in preference to boat speed. This is in part explained by the fact most boats are sailed **"shorthanded"** by average sailors. Few boats have a full crew with the skill and physical capacity to derive maximum speed from even the best of available sails and sail deployment devices. Historically, maximum boat speed has been irreconcilable with sail handling convenience and safety. Reconciliation of those priorities has evaded designers to the present date.

PRESENT STATE OF THE ART: A CRITICAL AND ONGOING SAIL DESIGN ASSUMPTION

Three-dimensional sail form has evolved consistently yet the two-dimensional triangular sail profile still dominates. That disparity is due primarily to a single, ongoing design assumption: **The back end of a boat's working sails cannot overlap any rig element.**

In 1925, it was unthinkable that the back end of a mainsail fitted with heavy horizontal wooden battens could pass across a boat's backstay as the boat turned through the wind. The battens would break. Designers eventually turned to supplementing underpowered triangular working sails with free flying sails for light air and downwind sailing.

Supplemental, or "**free flying sails**", are set and maneuvered forward of a boat's forestay, thus eliminating rig compatibility issues. Free flying sails attach to a boat only at their three corners and can employ an elliptical or semi-elliptical two-dimensional profile.

Such sails were suitable when the wind came from aft of a boat's beam, but they imposed a mast-mounted lateral support pole and frequent and dangerous on-deck sail and pole handling. Free flying sails would remain an application of elliptical sail form, but one for use in limited situations and that addressed neither optimum convenience, optimum economy or optimum safety.

FULL-BATTEN NON-OVERLAPPING MAINSAILS COMPARED TO FURLING MAINSAILS: 1980 TO DATE

By 1980, designs for larger, fully battened mainsails had gained popularity for racing boats with alternating or "running" backstays and for multihulls that had no backstays. For such boats rig overlap was not an issue.

Notwithstanding, a full batten mainsail and working jib were still underpowered in light air conditions except for very light sailboats. Most sailors considered the performance benefits of hoisted, full batten mainsails disproportional to their incremental cost and inconvenience. It remained unthinkable that a mainsail could overlap a companion permanent backstay, and even more remote that a self-tacking headsail might one day have genoa-equivalent sail area by overlapping a companion mast.

Today's convenience-oriented sailors either accept important safety and performance compromises or they supplement the undersized triangular profile of their standing headsail and mainsail with inconvenient, often dangerous free-flying sails. In most cases, owners opt for long-footed genoas that impose alternately tensioned port and starboard sheets. As seen below, small-roach or no-roach mainsails and triangular standing headsails are predominant on contemporary conventionally rigged sailboats with no hope for a transition to elliptical sail form.

THE PRESENT STATE OF THE ART – REALITY AND RHETORIC

The present state of the art reveals that:

1. Currently available working sails mirror underpowered 1980's counterparts, thus lacking versatility for a wide range of wind conditions;
2. As in1980, most boat owners forego convenient but underpowered self-tacking jibs, opting for long-footed roller furling genoas with separate port and starboard sheets; and
3. As in 1980, maximum boat speed in all conditions still requires dangerous on-deck sail handling, large costly sail inventories and a full complement skilled crewmembers.

CURRENTLY AVAILABLE WORKING SAILS HAVE NOT CHANGED SINCE 1980

Three highly knowledgeable boat owners recently built state-of-the art sailboats. Despite extensive experience and budgets, none of them escaped the perennial convenience and performance compromises that prevailed in 1980. The triangular two-dimensional sail profile still excluded sails that could reconcile optimum performance with optimum convenience and safety.

CURRENTLY AVAILABLE SAILS: PERFORMANCE-ORIENTED CHOICES

MULTIPLE HOISTED HEADSAILS FOR BEST PERFORMANCE BUT LEAST CONVENIENCE

Cruising World magazine's December 2002 cover story revealed that boat builder Peter Johnstone's "state-of-the-art" sails for his new 62-foot catamaran were reruns of 1980 counterparts. For its 7,000-mile initial cruise, the boat's shorthanded crew of four was made up of a veteran of four round-the-world races; a long-time charter boat captain; an experienced inshore racing sailor; and Peter Johnstone, builder of the highly regarded "J Boat" line of cruiser/racer sailboats. .

To meet changing conditions, Mr. Johnstone chose a variety of **task-specific hoisted headsails** with companion **deck stowage bags**. To change a headsail crew went forward, just as performance-oriented sailors had always done, accepting the accompanying effort and danger:

Mr. Johnstone sums up his sail changing procedure as follows:

" Each jib has an [on-deck stowage bag or] turtle. We **simply**

[1] drop the jib in the turtle,

[2] zip it, then

[3] unhank the sail,

[4] detach its port and starboard sheets]

[5] the next jib gets hanked on,

[6] port and starboard sheets are attached to it,

[7] we unzip the turtle, and

[8] hoist

A change takes ten minutes." (Peter Johnstone, Cruising World, pp. 40-45, December 2002).

CHANGING MULTIPLE HOISTED HEADSAILS IS MORE DIFFICULT ON A HEELING MONOHULL

A ten-minute sail change for a highly skilled crew on a catamaran can easily become an endless story with a bad ending for average sailors on a monohull, which heels more than a catamaran. The above eight -step maneuver is identical to sail change maneuvers sailors have performed since World War II and is just as dangerous and fatiguing as ever.

WHY PEFORMANCE-ORIENTED SAILORS CHOOSE HOISTED SAILS

Mr. Johnstone gave his reasons for choosing multiple hoisted sails as follows:

"Roller furling ... limits your sail selection and places too much weight up high... Roller furling makes more sense on a **heeling [monohull], where it's not safe to go forward of the mast.**"

Thus, Mr. Johnstone identifies four unsolved problems:

1. Furling headsails do not have the versatility to meet a wide range of conditions;
2. Furling configurations impose detrimental weight aloft;
3. No satisfactory alternative to multiple hoisted headsails is currently available; and
4. Going forward for on-deck sail handling is not safe, particularly on a monohull sailboats, which make up the overwhelming majority of existing sailboats.

If Mr. Johnstone could have conceived of a truly versatile hoisted headsail configuration that eliminated on-deck sail handling, **he would have installed it on his own boat**. The present state of the art offers not even a suggestion for truly versatile hoisted headsails that are safe and easy to use.

CURRENTLY AVAILABLE WORKING SAILS: CONVENIENCE -ORIENTED CHOICES

ROLLER FURLING GENOAS FOR OPTIMUM CONVENIENCE, NOT PERFORMANCE

Peter Johnstone wrote that going forward of the mast to change hoisted headsails was dangerous. Not surprisingly, most contemporary sailors agree. As a result, they simply get by with a single cockpit-controlled general purpose furling genoa.

In difficult situations, where "getting by" may not be sufficient, a general purpose furling genoa poses safety issues. If a long-footed furling genoa jams, a dangerous situation is in place. Furthermore, long-footed genoas cannot furl effectively to working jib size or smaller for heavy air use. Thus, a sail with compromised windward ability makes clearing dangerous windward obstacles even more hazardous. Walt Schultz, naval architect and owner of Shannon Yachts sums it up in saying,

> "...it is still impossible to roller furl a large overlapping genoa into a useable and safe working jib."(Ocean Navigator no. 100, 1999)"

As a genoa furls, its clew rises, causing it to lose effective sheet angles in precisely the conditions that most demand an effective headsail. Thus, boats with a single furling genoa are underpowered for light air conditions and are unable to meet heavy air conditions effectively. No single available headsail, whether hoisted or roller furling satisfies both performance and convenience priorities.

CURRENTLY AVAILABLE SAILS:

PERFORMANCE-ORIENTED CHOICES FOR LIGHT AIR AND DOWNWIND SAILING

FREE FLYING SAILS: A PERFORMANCE CHOICE THAT IGNORES CONVENIENCE AND SAFETY

For light air and offwind sailing versatility, Peter Johnstone's "screecher" **free-flying headsail** and **single-line furler** proved uncontrollable. After the voyage, he replaced them with a supplementary hoisted sail. Sailmaker claims for today's offwind sails and related "convenient" deployment gear repeat the unrealistic claims of 1980. Reality belies these claims:

" If you believe your sailmaker, screechers are user-friendly ... a well-orchestrated plan helps us tame the beast somewhat, but typically we all end up on our backs [exhausted]. Every time the [screecher] spanks us we take it down." "

"The continuous-line furler is "the latest development from the Volvo Race", according to its manufacturer. With a crew of 10, I'm sure the unit will suffice, but **for shorthanded sailing,** the furler unit has multiple flaws... Typically the furler jams, and a partially furled screecher flogs until the whole mess is wrestled into submission." (Cruising World, Peter Johnstone, pp. 40-45, December 2002).

Free-flying sails and single-line furling gear were introduced in the 1970's, when they exhibited the same shortcomings Mr.Johnstone suffered. Many sailors, including Applicant, tried and abandoned these products just as Mr. Johnstone would do twenty years later.

CURRENTLY AVAILABLE SAILS: A PERFORMANCE-WEIGHTED APPROACH

U.K. Yachting World editor, Andrew **Bray** supplemented his new boat's underpowered, boomed, roller-furling self-tacking jib with a free-flying light air sail, thus accepting dangerous on-deck sail handling in exchange for improved light air and offwind potential. He found no working sail combination that would have allowed him to dispense with supplementary free-flying sails.

CURRENTLY AVAILABLE SAILS: A CONVENIENCE AND SAFETY-WEIGHTED APPROACH

Sail magazine editor, Patricia **Wales** chose a small, boomed triangular jib set on an inner forestay for heavier conditions plus a general purpose roller furling genoa set on an outer forestay. Dual forestays enabled a convenient, but underpowered self-tacking inner jib useful only for high wind speeds, and a heavy furling genoa for medium wind speeds. Ms. Wales simply accepted the shortcomings of her furling genoa for true light air and offwind conditions. She found no available working sails that would have provided self-tacking convenience and safety combined with optimum performance.

NEITHER FURLING GENOAS OR FREE FLYING SAILS REDUCE LIGHT AIR MOTORING

Ms. Wales and Mr. Bray will no doubt have equal resort to motoring or motor sailing in light air conditions. Sailing shorthanded, Mr. Bray will use his hard-to-handle free flying sail infrequently, preferring to start his engine as wind speeds drop.

At an approximately equivalent wind speed Ms. Wales will give up on her underpowered furling genoa and start her engine. Ms. Wales speaks for most boat owner in saying,

"[We] are willing to give up a bit of performance in the interest of easy sailhandling... This is a tradeoff." (Wales, Sail, Feb. 1998).

Bill Schanen, editor of Sailing magazine, reiterated the majority view on conventional hoisted headsails, writing, "To set a headsail, someone has to go to the bow ...as in the old days. Only for the truly pure at heart, I'm afraid" (Schanen, Sailing, Jan. 2000).

No available headsail, whether hoisted or roller furling, satisfies both performance and convenience priorities across a range of wind speeds from five to thirty-five knots. Economical, efficient hoisted sail configurations cannot rival furling configurations for market share unless hoisted sail configurations can be deployed, reefed, and recovered from the safety of a boat's cockpit.

OVERVIEW OF THE PRIOR ART 1925 – 1980

In **1925**, **Manfred Curry** discovered that triangular wings and sails were the least efficient. Contrarily, he discovered that elliptical wings and sails were most efficient because they induced less aerodynamic drag and allowed a boat to sail more upright than a triangular counterpart. A boat that leans less is able to go forward more easily with less lateral slippage.

By World War II, aircraft designers had reduced elliptical wings to practice. Contrarily, sail designers assumed that the aft end or "roach" of a sail could not tack or jibe across any part of a boat's rig, thus prohibiting application of Mr. Curry's theory to working sails.

Eventually, unconventional rig designs would enable semi-elliptical mainsails for a small minority of sailboats. One such design approach, exemplified by diverse racing monohulls, specifies alternately tensioned port and starboard backstays. Other unconventional rig designs eliminate backstays, and a

few eliminate rigging altogether, thus enabling large-roach mainsails. Overlapping semi-elliptical, self-tacking headsails have been ignored entirely by contemporary designers, even for such unconventionally rigged boats. Consequently, a self-tacking headsail with sufficient power for light air use would remain inconceivable.

OVERVIEW OF THE PRIOR ART: 1980 TO DATE:

LIGHT AIR COMPROMISES FOR PERFORMANCE-ORIENTED SAILORS

In 1980, enthusiastic boat owners bought costly second-generation **free-flying headsails** to supplement the inadequate performance of triangular working sails. Second-generation free flying sails pretended to dispense with lateral support poles and offer improved convenience and safety. The sails proved unstable on downwind courses and as hard to recover as earlier free flying sails. True downwind sailing still required a lateral support pole.

Even with the most recent spinnaker recovery sleeves or furlers and retractable bowsprits, free flying sails remain altogether inappropriate for shorthanded sailing. Stated otherwise, free flying sails just aren't a workable sailing solution for the mainstream market composed of average boats sailed by average sailors.

OVERVIEW OF THE PRIOR ART: 1980 TO DATE:

LIGHT-AIR COMPROMISES FOR CONVENIENCE-ORIENTED SAILORS

Convenience-oriented sailors of the 1970's quickly accepted marketing claims that **roller furling sails** worked well in all conditions and satisfied convenience and safety priorities. These claims quickly proved unfounded. As concerned mainsails, triangular furling mainsails were underpowered and could jam in their mast slot, presenting a dangerous situation.

As concerned headsails, long-footed furling genoas did eliminate on-deck sail changes, but they could not meet a wide range of conditions. The promised versatility was illusory, as was the ease of use on all but the smallest boats. Certainly, deployment was more convenient than deployment of hoisted headsails. However, the high levels of physical effort and crew coordination required to tack and jibe

long-footed "general purpose" furling genoas offset much of their deployment convenience. As for safety, if a furling genoa jammed, it could not be lowered, giving rise to a dangerous situation.

The force of **gravity <u>facilitates</u> lowering a hoisted sail,** whereas **natural forces work <u>against</u> furling sail recovery**, imposing levels of physical force that can overwhelm crew and gear. Finally, triangular furling genoas cause excessive heel and provide poor mainsail interface.

<u>OVERVIEW OF THE PRIOR ART: 1980 TO DATE:</u>

<u>THE PRESENT STATE OF THE ART: MAINSAIL ROACH AND PERMANENT BACKSTAYS</u>

Steve Dashew, American boat builder reiterated an ongoing design assumption in 1992, writing,

> "The problem with most cruising rigs…is that the permanent backstay...gets in the way of an optimum sail shape. (Dashew, <u>Sail</u>, 1992).

A sailmaker's error resulted in a mainsail that overlapped the permanent backstay of a Dashew-designed boat. The accident led Mr. Dashew to recognize that a mainsail could overlap a backstay "to some extent", but he was unable to identify a reliable overlap limit. Mr. Dashew concluded that it would be impossible to develop universally applicable predetermined maximum roach overlap parameters. Once he had reached that conclusion, Mr. Dashew resolved his own rig overlap issues by eliminating backstays altogether for his future designs.

In 2001, Mr. Dashew confirmed that predetermined maximum roach parameters were unfeasible saying,

> "I don't think you can make a blanket statement about the maximum roach overlap that will work." (Steve Dashew, email communication with Applicant, 10/17/01).

Mr. Dashew's restatement of the insolvable nature of the problem and its complexity establishes first, that predetermined maximum roach parameters were **not obvious** and secondly, that if such parameters could be reduced to practice, they would constitute a major advance in the art of sail power.

Owners of existing boats or designers for the mainstream sailboat market cannot resort to eliminating backstays or other radical design changes to render overlapping self-tacking sails compatible with a particular rig geometry. For cost, marketing and security reasons, **few boat owners or boat buyers will accept the idea that a monohull sailboat does not lose a critical margin of safety if its design does not include a backstay.** Consequently, unconventional rigs, those having no rigging wires

whatever, or having forward and lateral rigging wire but no backstay, are not a viable option for designers and builders of sailboats for the mainstream market.

THE PRESENT STATE OF THE ART: THE MAINSAILS OF MOST BOAT ARE TOO SMALL

Larger mainsails could make possible smaller, more easily handled, task-specific headsails only, but the permanent backstay found on most boats precludes larger mainsails:

"Many sailors don't want to exert themselves sheeting in large headsails. During last fall's boat shows we couldn't help but notice the number of boats [that] offered standard with self-tacking jibs...A modern boat can sail quite nicely with a **large mainsail** and [100%] working jib" (Practical Sailor, May 15, 2000).

For lighter boats, the above statement confirms a renewal of interest in self-tacking convenience and also dissatisfaction with undersized mainsails and cumbersome long-footed furling genoas.

THE PRESENT STATE OF THE ART:

MOST BOAT OWNERS FAVOR CONVENIENCE AND SAFETY PRIORITIES

A majority of today's boat owners would choose convenient self-tacking headsails if such sails could adequately meet a wide range of conditions. Most boat owners sail shorthanded and want only two easily used sails that enable high average boat speed and low crew effort and risk regardless of conditions. Moreover, hoisted self-tacking sails could regain market share from costly furling configurations if only the hoisted configurations could be easily deployed, reefed, and recovered ffrom a boat's cockpit.

THE PRESENT STATE OF THE ART: DESIGN ASSUMPTIONS

Contemporary sail designers still assume that:

1. Predetermined maximum roach parameters for working sails of conventionally rigged sailboats are unfeasible;

2. Boats with small working jibs require supplementary furling headsails or free flying sails to meet light air and offwind sailing requirements;

3. Hoisted self-tacking headsails have no potential for regaining market share lost to furling headsail configurations;

4. Hoisted headsails can never be truly versatile or convenient; and

5. "Overlapping sail " and "self-tacking sail " are mutually exclusive sail properties.

The above assumptions have perpetuated triangular working sails, requiring boat owners to buy multiple headsails to meet changing conditions, or to "get by" with a single long-footed genoa with port and starboard sheets. In no way have boat owners been liberated from the inefficiency and handling difficulties of long-footed genoas or free flying sails.

PRIOR ART; DETAILED ANALYSIS 1980 TO DATE

In summary, furling gear appears on most contemporary sailboats while free flying sails are found on fewer shorthanded sailboats as owners realize that they use such sails infrequently. The unrelenting triangular two-dimensional profile of working sails still makes them unsuitable for a wide range of conditions. Truly versatile working sails are still not available. Detailed examination of prior art follows with a view to identifying the reasons for the unavailability of versatile working sails and to identifying:

1. what prior art has taught, explicitly or implicitly, about two-dimensional profiles for working sails;

2. what prior art has not taught or even implied about two-dimensional profiles for working sails.

The following detailed analysis of sail design history addresses **"conventionally rigged sailboats"**. That term as well as others is explained below for reasons of precision and reader convenience. Notwithstanding, a person skilled in the subject matter of the present cause, or a **"skilled sailmaker"**, would be familiar with each of those terms.

THE PRIOR ART: DETAILED ANALYSIS

THE SHORTCOMINGS OF TRIANGULAR SAILS: 1925 TO DATE

Triangular sails produce a maximum of aerodynamic drag and heel. Although they are typically thirty-percent smaller than counterpart semi-elliptical sails, triangular sails induce more heel that make a boat

harder to control, uncomfortable, and eventually unsafe. Also, triangular sails twist easily, compromising efficiency.

"A long, slender elliptical airplane wing has ...little or no twist. A triangular sail is opposite in all respects. It is relatively short, and it twists, ...lowering its effective height.... Twist makes stubby rigs out of tall rigs."

"The wings [of] any aeroplane or great sea bird in flight are beautifully designed, with no twist at all, or very little. Birds and airplanes have wings that respond dynamically to changing conditions, wings that can flex and that are ideally shaped. (Bethwaite, Performance Sailing, Performance Marine, p. 199 (1993).

DESIGNERS CONSIDERED SEMI-ELLIPTICAL WORKING SAILS UNFEASIBLE: 1925 TO DATE

Since 1925 **designers have ignored semi-elliptical working sails, dismissing them as unfeasible** on both theoretical and practical levels. A leading sail designer expressed this position in a widely read book on sail design:

"[Headsail battens] are unseamanlike appendages if they have to come into contact with the mast or shrouds when tacking...There is no point in trying to build up a roach on the leech of ...a **[head]sail**, because this would defeat its own object. The extra cloth would probably cause the leech to foul the mast, which in turn would break the battens. If a greater area is desired in a headsail which is tall and narrow, it is better to draw the clew further aft, so that it overlaps the mast and the sail achieves a lower aspect ratio." (Sails, pp..87- 88, Jeremy Howard-Williams, Adlard Coles Limited, (1974)).

Mr. Howard-Williams also wrote that battens couldn't support a large **mainsail** roach in upwind conditions. He reasoned that it was better to use a smaller mainsail and regain needed sail area by resort to long-footed genoas and free flying downwind sails. His performance-oriented assumptions would continue to influence mainsail design for the foreseeable future.

Thus did a leading 1970's sail designer further entrench three sail design assumptions:

1. Standing headsails should not have a roach;
2. The best way to increase the power of a standing headsail was to lengthen its foot, and
3. Large mainsail roach was a poor way to gain sail area.

RIG OVERLAP AND SAILBOAT GEOMETRY: 1980 TO DATE

In an era of easily broken wooden battens, increased sail area was achievable only by resort to long-footed triangular genoas, taller masts, and free flying sails. Unfortunately, lengthening a headsail's foot made it harder to handle and disturbed interface with a companion mainsail. In addition, a long-footed overlapping genoa and its sheets violently fouled a boat's mast and rigging each time it tacked or jibed, even by the best of crews.

Tall masts were not cost-effective, and costly free-flying sails were unsuitable for boats sailed shorthanded by average sailors. Nonetheless, designers clung to old assumptions about roach size, rig overlap, and the feasibility of cockpit control for hoisted sails.

PREDETERMINED MAXIMUM ROACH OVERLAP PARAMETERS: 1980 TO DATE

For sail designers, a conventionally rigged sailboat was a hull encumbered by a cage of spars and wires that absolutely precluded overlapping mainsails and self-tacking headsails. Thus, the mainsails and self-tacking headsails of conventionally rigged sailboats uniformly passed clear of companion permanent backstays and masts, respectively.

Boat builder Steve Dashew's accidental experiment with overlapping mainsail roach only served to convince him that predetermined roach overlap parameters were unfeasible. Mr. Dashew's conclusion reflected the design assumption that has unrelentingly condemned a majority of existing sailboats to underpowered mainsails and self-tacking headsails. Similarly, the true potential of hoisted, self-tacking sails would remain unrealized.

DETAILED ANALYSIS: HOISTED WORKING JIBS AND RIGID EXTERNAL SPARS: 1980 TO DATE

In 1980, alternately tensioned port and starboard sheets were the dominant headsail control configuration. Most boat owners had replaced convenient self-tacking configurations with overlapping furling genoas that imposed alternately tensioning and releasing port and starboard sheets. Self-tacking

headsails, particularly those set from rigid jib spars, had also fallen into disuse. A majority of boat owners had abandoned underpowered triangular jibs and cumbersome rigid jib spars, such configurations being useful only in wind speeds above fifteen knots. Subsequent efforts to revive boat-owner-interest in self-tacking jibs would have limited success due to the performance limitations of triangular sail form; the inconvenience of conventional hoisted sails; and the cost of companion rigid jib booms.

THE BIERIG RIGID EXTERNAL SPAR 1985

One attempt to revive interest in external jib spars is seen in US Patent 4,503,796 to Bierig (1985) : The **Bierig** patent covers a curved, rigid half-wishbone that rotates inside a large sleeve sewn to a sail. The patent argues that flexible battens break easily whereas a rigid spar will not. Experience proved the contrary. The owner of Freedom Boats in the United Kingdom was obliged to replace the cumbersome curved Bierig spar on his own boat and carry a second one on deck as a precaution against recurrent breakage.

Interestingly, Freedom boats had no rigging wires whatever, thus presenting an ideal configuration for an overlapping mainsail or headsail. Even though a positive-roach headsail would have had only the boat's mast to cross when tacking and jibing, its jib was a conventional underpowered triangular one. Thus, even in the case of a boat with no rigging wires, a positive-roach jib was never considered, even for a configuration that presented minimum obstruction to tacking and jibing a headsail having a rig overlap. Old assumptions still controlled sailboat design.

Nowhere did Bierig suggest that the aft end of a sail could overlap a boat's rig. In fact, Bierig neither depicted nor described rigging wires at all in its text or drawings. In Bierig's Figure 8, the rigid Bierig spar leading diagonally upwards from the clew of the mainsail is longer than the sail's foot. The patent promised that the mainsail could be lowered with the aid of jackline 51. This is doubtful, particularly in real sailing conditions.

At best the sail could have been lowered on a model boat. On a real boat in real sailing conditions a mainsail must quickly and easily assume a reefed or lowered configuration that threatens neither crew nor gear. Once lowered partially or entirely, the mainsail configuration seen in Bierig's Figure 8 would not be firmly attached to the mast. Consequently, the sail would flail dangerously, threatening crewmembers and quickly destroying the mainsail and its spar. In no way could the depicted sail be

reefed or lowered safely. The sail would be safe only in a lowered configuration, and even then, only after crew had gone forward to secure the sail and spar: a dangerous and inconvenient prospect at best.

Nowhere did Bierig suggest that its rigid spar might lead downwards from it clew to the boat's mast. Ultimately, in Figure 13, Bierig resorted to a conventional horizontal boom, thus dropping the pretense that a diagonal Bierig spar could control a mainsail's foot in real sailing conditions. In fact, the Bierig spar was never intended to be functional with mainsails. Mainsail claims included in Bierig would not have worked in real sailing conditions, and they ave not been reduced to practice.

The series of heavy, cumbersome Bierig spars shown in the upper part of the sail of Figure 13 would prevent safely and easily raising, reefing, or lowering the sail and would be dangerous to crewmembers during any such maneuver. Simply stated, the Bierig spar, as shown in the patent would not work for controlling a mainsail even in the best of conditions. While Bierig addressed the convenience of self-tacking jibs, the patent disclosed nothing relevant to an overlapping, self-tacking semi-elliptical headsail. In the final analysis, **the subject matter of Bierig was a rigid spar**. Bierig replaced semi-rigid battens with a rigid spar, reasoning that battens were nonfunctional for booming a sail whereas the Bierig rigid spar was functional. Contrarily, Applicant's unique semi-rigid batten configurations eliminate rigid external spars including the Bierig spar, thus presenting a first reason why the prior art pertinent to rigid spars in no way affects patentability of Applicant's system.

Bierig specifically stated that full-length battens could **not** control a sail in either heavy or light air. conditions (see Bierig, p. 1, lines 26-44; p. 2, lines 14-26). Bierig substituted rigid spars for battens, stating,

"For full length battens, we can now use pre-curved rigid spars instead of battens" (p.3 lines 17-18.

In part, the new and unexpected results produced by Applicant's System are generated by Applicant's universally compatible predetermined maximum roach parameters. Each System sail embodiment complies with those parameters. Those parameters have heretofore been considered unfeasible (see Amendment A, pp. incorporating Bierig neither teaches nor infers anything concerning predetermined roach overlap parameters or rig overlap for working sails:

"A further advantage [of the rigid Bierig spar] is that sails with large roach (convex curvature of the after edge) can be more easily controlled and put less demanding loads on the sailcloth."

The use of the term "large roach" in Bierig taught nothing about predetermined maximum roach parameters. Nor did Bierig disclose or imply anything whatever about rig overlap. A concerns leech control and sailcloth loads, Bierig taught nothing beyond the well-known art pertinent to conventional wishbone spars. The subject matter of Bierig pertained to a pivoting half-wishbone without the slightest pertinence to rig overlap at the back end of a sail or predetermined maximum roach parameters. Moreover, much of what Bierig claimed would not be possible in real sailing conditions, particularly as concerns mainsails.

Bierig presented small variations on well-known external wishbone devices; it promised to revive commercial interest in a rarely used device; and it occupied a crowded classification. Bierig spars still appear on a few boats to control underpowered triangular jibs. The complexity and cost of the spars has limited their commercial success.

THE HOYT RIGID EXTERNAL SPAR 1995

A second effort to revive interest in rigid external jib spars appeared in US Patent 5,463,969 to Hoyt (1995). A rigid Hoyt boom costs more than a Bierig spar, provides fewer control functions, and imposes major structural changes to a boat's deck and invasion of its below-deck space.

Purchase and installation costs and the inefficiency of companion triangular jibs limited the commercial potential of both the Bierig and Hoyt spars. Despite self-tacking convenience, the Hoyt boom failed to resolve the following shortcomings:

1. High cost and encumbrance of heavy external jib spars;
2. Inadequate sail area in wind speeds of less than fifteen knots;
3. Difficult, risky on-deck deployment, reefing and recovery maneuvers.

DETAILED ANALYSIS: HOISTED MAINSAILS AND RIGID EXTERNAL SPARS 1980 TO DATE

BOOM FURLING PRIOR ART TAUGHT ONLY THAT LARGE ROACH MAINSAILS WERE APPROPRIATE TO UNCONVENTIONAL RIG DESIGNS

By 1980 Freedom boats with freestanding masts were using mainsails with modest positive roach, but similar benefits were still denied to boats with permanent backstays. By 1990 functional furling booms had appeared. Furling boom technology targeted convenience-oriented boat owners with its apparent furling ease, and performance-oriented owners with its ability to furl full-batten mainsails. However, large roach mainsails were not envisioned for furling booms due to the high levels of luff friction large mainsail roach imposed. Furling booms would have limited success through 2000 due to difficulty of use and high cost.

Furling boom technology did not pertain to sail shape or rig overlap. In fact, overlapping mainsail roach was incompatible with furling boom function. Finally, furling booms ignored basic functional and cost issues:

A. Could a mainsail deployment system combine the functional and economic advantages of furling and hoisted sail deployment configurations while accommodating an Optimized mainsail?

B. Were predetermined maximum roach overlap parameters for conventionally rigged sailboats feasible?

Boom furling patents did not address the above issues, nor did manufacturer's specific instructions to sail makers. Where manufacturers' instructions set mainsail roach limits at all, such limits related exclusively to a boom's mechanical function. When present, such instructions set limits well inside any that might be posed by a companion permanent backstay. A subsequent review of recent boom furling patents reveals that <u>they address only the **front** end of a mainsail</u>. Leech shape, roach size, and rig overlap <u>have never been relevant</u> topics in furling boom prior art.

DEPLOYMENT, REEFING AND RECOVERY OF HOISTED WORKING SAILS: 1980 TO DATE

1. Lowering or reefing an externally-boomed mainsail or hoisted jib was difficult and dangerous. By 1980 improved reefing for hoisted mainsails had appeared, but for want of easily reefed hoisted jibs, furling headsail configurations had replaced reefable hoisted jibs, rendering them obsolete.

2. However, furling genoas proved only marginally satisfactory as a heavy weather alternative to multiple hoisted headsails. Nonetheless, a majority of boat owners chose furling genoas, accepting compromised performance in exchange for safety and ease of use.

3. Mainsail deployment, reefing, and recovery has been facilitated by Lazy Jacks and Dutchman configurations, which are vertical lines that control a mainsail during deployment, reefing, and recovery maneuvers.

TOPPING LIFTS AND VERTICAL DEPLOYMENT CONTROL LINES: 1980 TO DATE

1. A **"Topping lift"** is a line running from a boom's aft end to a point just below a boat's masthead that prevents the aft end of a sailboat's boom from falling to the deck.

2. **Lazy jacks"** are paired lines running upwards from a boat's boom along either side of its companion mainsail to contain it during deployment, reefing, or recovery. Lazy jacks are notorious for snagging a sail's battens during hoisting maneuvers, thus being inconvenient, even dangerous in difficult conditions or confined quarters.

3. U.S. patent 4,688,506 to **Van Breems** (1987) introduced a sail deployment control System that combined a topping lift and vertical lines running through eyelets in a sail to prevent flogging during sail handling maneuvers and to automatically fold or "flake" a mainsail as it is reefed or lowered. Unlike lazy jack lines, **Dutchman** lines run through a sail and cannot snag battens as the sail is hoisted. Both Systems have been widely used for mainsails, but most sailors have chosen lazy jacks, which are easier to install and do not require punching a series of holes in a mainsail.

4. Both Systems were inappropriate for jibs because both had been designed to function only with a rigid external spar. Since external jib spars as well as hoisted working jibs had fallen into disuse by 1980, the use of deployment control Systems for working jibs was largely a moot issue.

MARKET POTENTIAL FOR HOISTED WORKING HEADSAILS: 1980 TO DATE

By 1980 furling configurations had replaced most hoisted jibs except for racing applications. Hoisted working jibs were considered hard-to-use, fatally underpowered sails with no further functional or commercial potential.

SEGREGATED PERFORMANCE AND CONVENIENCE PRIORITIES AS A MARKETING STRATEGY: 1980 TO DATE

For a certain time, segregated design priorities enabled sailmakers to selling five sails instead of two to performance-oriented boat owners, and to sell furling configurations to convenience-oriented ones. However, owners progressively came to understand that sail area gained via free flying sails imposed more than an acceptable measure of work and risk, and that furling configurations hardly satisfied a wide range of conditions. In response, sailmakers and boat builders intensified promotion of tall mast configurations, or **"tall rigs"** to gain sail area. However, tall rigs were costly and did not meet market demands satisfactorily.

TALL RIGS HAVE NOT MADE TRIANGULAR SAILS MORE EFFICIENT: 1980 TO DATE

"Tall rigs" add weight aloft, which can impose major structural modifications to a boat's deck and perhaps to its ballast and, consequently, major increases in boat cost. In addition, a taller mast interfere with a boat's passage under bridges. At a minimum, the cost of a new mast and rigging represents an important percentage of a boat's original cost.

Raising the small, drag-inducing head area of a triangular sail to a higher wind zone may have some performance benefit, but not one that most boat owners consider justifiable. In the final analysis, the heel-inducing effect of a triangular sail is not reduced by use of a taller mast.

TALL RIGS HAVE NOT PROVEN COST EFFICIENT: 1980 TO DATE

Tall rigs are found on less than 5% of existing sailboats because their limited practical benefit does not justify their cost for a predominance of boat owners.

REFERENCE CALENDER

1925: Manfred Curry identified the elliptical distribution of force over a sail as ideal for minimizing heeling forces while obtaining maximum forward drive, or optimum performance. (Aerodynamics of Sails and the Art of Winning Races, Collection Biblio Voile, 1925)).

1940: By WWII, elliptical airplane wings exemplified by the British Spitfire were common, whereas elliptical sails remained theoretical.

1945: Postwar designers segregated "racing performance" and "cruising convenience" objectives. The primary postwar design challenge would be getting more of a more efficient and more easily controlled sail area to work with conventionally rigged sailboats

1960: Progressively, racing technology such as powerful winches and aluminum spars began to "cross over" to cruising, prompting boats manned by smaller crews to demand sails that allowed higher speed with less effort.

1975: Mainsail and headsail furling devices had enabled cockpit-control of inefficient triangular working sails. Designers would promote long-footed genoas and free flying sails to compensate for the shortcomings of available working sails.

1980: External jib booms had fallen into disuse. Furling headsails dominated the headsail market, replacing hoisted headsails except where specified by racing rules,

1985: Full batten non-overlapping hoisted mainsails appeared as did the first functional in-boom furling devices.

1990: Various in-boom furling devices appeared, but they could not accommodate large-roach mainsails. No furling boom design addressed maximum rig overlap.

2002: Cockpit-controlled, hoisted, overlapping self-tacking semi-elliptical sails for all-condition sailing remained inconceivable for even the most knowledgeable boat owners, sail makers and marine architects.

SAIL DESIGN FOR THE TWENTY-FIRST CENTURY

"Universally compatible Optimized" sails remain unavailable; indeed, unimaginable, as designers persistently segregate performance and convenience objectives.

"Sail System design" is still only an exotic term, and the turbulence generated by triangular working sails excludes optimum working sail interface.

SAIL DESIGN FOR THE TWENTY-FIRST CENTURY: AVAILABLE WORKING SAIL DESIGNS

Available working sails for conventionally rigged boats consist of :

A. Underpowered triangular jibs, or, as a compromised substitute, long-footed, overlapping triangular furling genoas, and

B. Relatively small non-overlapping full-batten mainsails.

SAIL DESIGN FOR THE TWENTY-FIRST CENTURY: UNAVAILABLE WORKING SAIL DESIGNS

As seen above, prior art infers nothing concerning Optimized working sails, and designers continue to ignore the following design objectives altogether, or to regard them as unfeasible:

1. Cockpit-controlled, hoisted all-condition, self-boomed, self-vanged Optimized working sails installed without modification to boat or rig;
2. Hoisted mainsails and self-tacking jibs that combine optimum convenience, safety, and performance;
3. Overlapping self-tacking hoisted headsails and mainsails;
4. Reliable predetermined roach overlap parameters for Optimized headsails and mainsails;
5. Optimum interface yielding synergism between working sails;
6. Self-boomed semi-elliptical hoisted sails to lower boat cost for boat buyers and increase profit for boat builders; and
7. A sail System that reduces operating costs for commercial users.

SUMMARY OF THE PRESENT INVENTION

In accordance with the present invention, a universally compatible System of hoisted Optimized working sails for conventionally rigged sailboats comprising new combinations and new uses of known and new materials and concepts.

SYSTEM-SPECIFIC TERMINOLOGY

Although a skilled sailmaker would have no problem understanding and using the following terms, they are set forth below for reasons of precision and reader convenience:

1. A "**semi-elliptical sail" is** a sail having a linear leading edge and an approximately elliptical trailing edge.
2. "**System"** denotes the embodiments and ramifications of the present invention.
3. An **Optimized** sail is a semi-elliptical sail that conforms to predetermined roach overlap parameters that reconcile the greatest possible rig-compatible-sail-area with the most efficient possible leech curve.
4. "**predetermined maximum roach overlap parameters"** denote parameters for predictably assigning the following properties to a sail:

   A. reliable tacking and jibing;

   B. maximum feasible sail area; and

   C. an approximately elliptical leech curve.
5. "**Maxmain"** denotes an Optimized mainsail:
6. "**Maxjib"** denotes an Optimized headsail;
7. "**Optimized working sails**" denotes a combination of a Maxjib and a Maxmain;
8. "**overlapping**" and "**non-overlapping**" are terms describing the relationship between a sail's leech and a companion rig element..
9. A **non-overlapping Maxjib** is a headsail whose approximately elliptical leech contacts neither a companion mast nor companion rigging while tacking and jibing.
10. An **overlapping Maxjib** is a headsail whose approximately elliptical leech does contact a companion mast or rigging while tacking and jibing.
11. An **overlapping Maxmain** is an Optimized mainsail whose approximately elliptical leech contacts a companion permanent backstay while tacking and jibing.
12. A "**self-boomed"** sail is one whose foot is held in horizontal extension by the sail's System batten or batten substitute layout rather than an external spar.
13. A "**self-vanged" sail** is one whose clew resists upward movement as its sheet is eased without resort to an external spar and vang combination.

14. **"Counterpart"** triangular and semi-elliptical sails have identical foot and luff lengths but different leech profiles.

REPETITIVE IDENTIFICATION NUMBERS

The drawings of the present cause, **"the drawings"**, in combination with its Specification and Claims, describe the System in detail sufficient to enable a skilled sailmaker to make and use the System. In the interest of clarity, where many identical parts appear in a drawing, only exemplary reference numbers are used. For example, **Figure 1** shows only an exemplary number of Dutchman eyelets **69** and Dutchman vertical control lines **72** in order to avoid an excess of reference numerals, which would mitigate clarity.

SYSTEM DESIGN OBJECTIVES

The System reduces to practice the following objectives:

1. Cockpit-controlled working sails that eliminate on-deck sail handling, costly sail inventories, and below-deck sail stowage.
2. Optimized self-boomed, self-vanged positive roach working sails compatible with the rig elements of any sailboat.
3. Elimination of rigid external spars as well as embodiments for use with rigid external spars, according to boat owner preference;
4. Working sails with fully integrated deployment, single-line reefing, and recovery functions.
5. Predetermined maximum roach overlap parameters enabling universally compatible, overlapping mainsails and self-tacking headsail without modification to boat or rig.
6. Optimum interface between a boat's working sails;
7. New combinations of existing batten and sailcloth technology that enable lighter batten configurations or, alternatively, batten free sails.
8. Cost efficient alternatives to tall rig configurations; and
9. A new form of sail power that was neither taught nor anticipated by the prior art.

PRIOR ART IGNORED THE POSSIBLITY OF HOISTED, OVERLAPPING SELF-TACKING HEADSAILS AND MAINSAILS

Since furling booms represent the most recent use of hoisted sails, a close review of furling boom patents and other publications concerning furling booms will be useful in identifying the limits of the prior art as concerns specific leech parameters and rig overlap. Furling booms can accommodate full-length horizontal mainsail battens, and they pretend to rival the convenience of in-mast furling devices, which cannot accommodate such battens.

The fact that a sail has full-length battens in no way addresses specific leech parameters or rig overlap. For example, it is possible for a triangular mainsail to have full-length battens, but it is impossible for the leech of a triangular mainsail sail to have a convex leech, let alone a leech that overlaps a companion permanent backstay. Therefore, the fact that a patent may reference batten in no way compels that such a patent pertains to specific leech curve geometry, rig overlap, or rig compatibility.

FURLING BOOM MANUFACTURER'S INSTRUCTIONS TO SAIL MAKERS

Furling boom manufacturer's instruction to sail makers as well as the related patents are examined immediately below with a view to exposing the total body of furling boom prior art, not just the patents themselves. Those instructions provide manufacturer-specific mainsail roach limits relating only to a boom's interior volume and mechanical features. Such **proscriptions** dictate a minimal mainsail roach that would inevitably fall "inside" of a companion permanent backstay.

"Super-high-roach mainsails are therefore not suited for in-boom-furling." (Mc Geary, Cruising World, October 2000).

Furling boom manufacturers restrict mainsail roach to a percentage of "E", or usable boom length, which bears no relationship whatever to a boat's permanent backstay. Varying boom lengths can be used for a given boat, thus presenting various "E" measurements relative to a boat's permanent backstay. Accordingly, "E" is not pertinent to predetermined parameters for leech shape or rig overlap.

A sail making manual for a recently introduced furling boom recites a maximum roach limit of 25% of "E", stating that "The P [maximum hoist of the luff of a mainsail] and E [horizontal distance from the aft surface of mast to mainsail clew] are rig measurements and the sail must fit within these parameters." (Schaeffer sail making guide, 2001).

Another recently introduced furling boom's sail making manual limits mainsail roach to "the lesser of either 20% of "E" [horizontal distance from a mast's aft surface to a mainsail's clew] or 10% of the leech length," (Furlboom sail making manual p. 13, revision 010212 RBS), thus excluding a mainsail roach that overlapped a sail's permanent backstay.

FURLING BOOM MANUFACTURERS REITERATE THAT BOOM FURLING MAINSAIL SHAPE RELATES TO A BOOM'S INTERIOR VOLUME AND I MECHANICAL FEATURES: 1990 TO DATE

Manufacturers' responses to Applicant's furling boom inquiries invariably made clear that neither rig overlap nor elliptical leech form were pertinent furling boom design issues. To the contrary, manufacturers took pains to preclude large roach mainsails in order to avoid mechanical problems attributable to excessive luff friction.

What furling boom manufacturers did consider relevant was how a furling boom's mechanism interacted with the **luff** of its companion mainsail and whether the sail's furled volume fit into the boom. Limits on roach size pertained uniquely to a boom's furling capacity. Neither specific leech form nor rig overlap were relevant considerations. Furling boom manufacturers were content to look no further than specifying a boom that passed clear a boat's permanent backstay and furled a companion mainsail that might or might have a nondescript roach. The relationship between a boat's permanent backstay and the leech of its mainsail does did not concern furling boom manufacturers. Exemplary responses to Applicant inquiries follow. Those responses establish that furling boom manufacturers view predictable rig overlap as extraneous to the subject matter of their activity:

A. "I've spoken with our Lead Engineer regarding your many questions. Basically, our feeling is that the only limiting factor on roach is twofold:

1. Getting the sail past the backstay
2. Keeping the battens parallel to the foot of the sail to allow proper furling. (Schaefer Marine correspondence with Applicant, 10/24/2001)

B. "To begin with, our sails can allow a maximum roach of 20% of "E". This roach has to be evenly distributed along the leech. (read, no fathead as in an America's Cup or Race Multihull sail.) The reason for this is twofold. First, the sail must fit inside our internal claw and roller assembly. Second, as you stated, the compression of "fat head" roach tends to add too much unnecessary friction to the System. "On our test boat, a Newport 41, we have about four inches of overlap...in [the lightest conditions] we have to bang on the backstay to clear it." (Furlboom correspondence with Applicant, 10/15/2001)

"Furlboom's roach is the most generous in the industry. The maximum roach is described in the Sail Making Instructions. Furlboom is tapered so it is important that the sail roll forward somewhat evenly or the volume at the aft end of the sail becomes too large for the boom shell." (Furlboom correspondence with Applicant, 10/24/2001)

Thus, even the most recently introduced furling boom designs restrict maximum roach according to interior boom volume and usable boom length. A percentage of usable boom length bears no relation to whether a sail's aft end will tack or jibe across an element of a boat's rig. A four-inch roach on a forty-one foot boat is negligible in the context of large-roach mainsails.

A percentage of usable boom length neither prescribes nor suggests an elliptical or any other specific leech curve form. Banging on a boat's backstay to clear a nondescript four-inch mainsail roach confirms assumptions that furling boom manufacturers consider jibing and tacking a mainsail with any backstay overlap, however small, as a hit-and-miss proposition. In this context, furling boom manufacturers and designers obviously consider predetermined maximum roach overlap parameters unfeasible. In the final analysis, furling boom manufacturers have no desire to involve themselves in issues beyond the function of their products.

C. "Back to your backstay overlap [question], it is really more a question of wear and tear on your leech as it scrapes on the backstay....I can not even guess what the maximum percentage of overlap can be so I will have to leave that to a sail maker. As long as you don't exceed **our** maximum roach limitations, getting your battens around the backstay is up to you." (Furlboom correspondence with Applicant, 10/15/2001)

Reliable predetermined maximum roach overlap parameters are as unimaginable to sailmakers as they are to boom manufacturers. Even less conceivable is the idea that contact between a mainsail and a permanent backstay might result in a **performance benefit** as opposed to "wear and tear".

FURLING BOOM PATENTS PRECLUDE LARGE ROACH MAINSAILS: 1990 TO DATE

Functionally, the increased batten length of a larger mainsail roach impedes furling boom operation by increasing forward batten pressure against a sail's mast track. As seen above, furling boom manufacturers preclude mainsail roach that might interfere with the smooth functioning of their respective products. Quite naturally, furling boom patents avoid self-defeating elements, notably friction-inducing roach specifications that might exceed a furling boom's operational limits. Simply stated, maximum roach mainsails are the enemy of smooth furling boom function.

The specific language of furling boom patents issued during the 1990's neither teaches nor suggests anything concerning backstay overlap or predetermined maximum roach parameters. Those patents address only a mainsail's leading edge while teaching or suggesting nothing about a mainsail's trailing edge.

MARECHAL ADDRESSES ONLY THE LEADING EDGE OF A MAINSAIL

Furling booms promised two advantages over rival in-mast furling devices: first, a boom furling sail can be lowered in the event of mechanical problems; second, and most important commercially, furling booms can use full length battens to minimize mainsail flogging, thus increasing mainsail life.

US Patent 5,445,098 (1994) to Marechal covered the use of supplementary sail slides at a mainsail's luff. Marechal taught nothing whatever about the trailing edge of a mainsail. The sail depicted in Marechal might as well have been triangular so long as the boom could accept the market-mandated full-length battens. Marechal's text (p. 1, line 52) specifically excludes any possibility that it taught or anticipated anything concerning an overlapping mainsail or rig compatibility.

"The head and the **possible** battens of the sail are attached to said luff (emphasis supplied)..."

For Marechal, battens were **optional**. For a positive roach sail, battens were **obligatory**. Positive roach in the absence of battens was impossible. Thus, Marechal taught nothing whatever about the specifics of mainsail roach or rig compatibility.

Marechal simply allowed that its luff-furling device provided a new and improved means to furl mainsails. Its text and drawings reveal a battened mainsail of **arbitrary form** that might as well have had a straight leech or even one that was concave. The text of Marechal would have been equally

served had the drawings merely shown an exploded view of a mainsail that omitted the aft end of the sail altogether.

Nowhere does Marechal depict or describe a boat's rigging wires, notably a permanent backstay. Nor does Marechal ever refer to or identify a sail's leech. Contrarily, Marechal **did** specifically identify its mainsail's luff, while **omitting** to identify the sail's leech:

"In accordance with the invention, the **luff** 7 of the **mainsail** 3 (emphasis supplied) is mounted...." (Marechal, p. 2, line 37-40).

Marechal's failure to identify the sail's leech confirms that the patent does not pertain to either roach specifics or rig compatibility.

In **Fig.1**, of Marechal, the numeral "3" identifies Marechal's mainsail. The patent reveals no separate identifying number or descriptive text pertaining to a leech of a sail. Had Marechal intended to teach anything about a sail's leech, it would have assigned a specific number for the sail's leech, as it did for the sail's luff.

As a corollary, the fact that the patent issued confirms that the pertinent prior art considered leech curve specifics irrelevant to the subject matter of Marechal, which neither explicitly nor implicitly refers in any way to a sail's leech curve. .

Marechal cited no prior art that teaches or infers anything whatever concerning a sail's leech, even as it might concern the functioning of the Marechal boom. Nor did Marechal or the referenced prior art suggest that the either a sail's leech curve or compatibility with a conventional sailboat rig was pertinent to the subject matter of the patent.

Had pertinent prior art taught or suggested that either a sail's leech curve or its rig overlap was relevant and critical to the subject matter of Marechal, Marechal's failure to address and distinguish those issues from its claims would have resulted in a denial of the patent.

Marechal's claimed novelty consisted of a boom for furling a mainsail with supplementary luff slides attached to its full-length luff tape, as opposed to one having no such supplementary luff slides. The shape of the sail furled by the Marechal boom was irrelevant so long as it fit into the Marechal boom.

Neither Marechal nor the prior art taught or inferred anything about an Optimized mainsail, that is, a semi-elliptical mainsail having predetermined maximum roach overlap parameters that overlapped a companion permanent backstay. After initial boat show appearance in reduced display form, the Marechal furling boom was not offered for sale. Nor did the boom claimed in US Patent 5,445,098 (1994) to Moessnang ever reach the market. Moessnang claimed a boom that furled a supplementary sail slide, suggesting a parallel with Marechal. Nonetheless Moessnang received a patent even though its supplementary slide was at the companion sail's head and did not furl into the boom. As indicated below, this patent may have issued because it disclosed a small advance in a crowded category.

MOESSNANG DID NOT ANTICIPATE ANY SPECIFIC SAIL PROFILE OR RIG COMPATIBILITY

US Patent 5,445,098 (1994) to Moessnang addresses the mechanics to rolling a sail into a boom, not a sail. As seen below, the patent issued for an advance in the narrow field of furling boom mechanisms without regard to the shape of the leech of a companion sail. Moessnang exemplifies furling boom patents that ignored entirely the trailing edge of a companion mainsail, as did the prior art covered in that patent. Furthermore, Moessnang, like Marechal, neither taught nor inferred anything concerning maximum mainsail roach parameters for conventionally rigged sailboats, elliptical leech curves or rig compatibility.

MOESSNANG EXPLICITLY STATED THAT A MAINSAIL'S LEECH CURVE WAS IRRELEVANT TO THE CLAIMED INVENTION

Neither Moessnang's text nor its drawings specifically described or identified a mainsail leech or a companion rig. Rather, Moessnang described a mainsail in the abstract, nowhere depicting a sailboat's supporting wires, or rigging. As such, the patent mirrored Marechal, teaching and inferring nothing about a mainsail's leech curve, roach dimensions, or rig overlap.

Moessnang's drawings and text each confirmed that neither prior art nor the patent, itself, taught or implied anything whatever pertinent to a mainsail's leech curve, even as it might concern the claimed furling boom. **Figures 1a and 1b** depict a boom furling mechanism and an approximate outline of a mainsail, to which the patent never refers.

Figure 6 of Moessnang shows a typical full-batten mainsail with a narrow head, one that would not contact a permanent backstay if surrounded by a proportionally scaled conventional sailboat rig. Nor does the mainsail seen in Moessnang's **Figure 7** infer any specific leech characteristics. That figure concerns only the front end of the sail. The leech curve of the sail of **Figure 7** was entirely arbitrary and irrelevant to the patent's claims, as was the leech curve shown in Marechal.

As with Marechal, Moessnanag's claims depended exclusively its boom's capacity to furl a sail's leading edge. The text and drawings of both patents ignored entirely the specifics of a mainsail's aft end. No sail described or depicted in Marechal or Moessnang reveals or anticipates anything about maximum roach parameters overlap or rig overlap for conventionally rigged sailboats. In fact, **Moessnang's drawings show no rig whatever**.

Moessnang's text purports to show a "rig" at its **Figure 7,** but **no rig is shown**, only a generic mast, a generic sail, and a boom. No forestay, shrouds or backstay is shown. Thus the word "rig" as used in **Moessnang** is limited to a boom and companion mast. Since no permanent backstay or specific leech curve parameter is shown in the drawings or referred to in its text, there is no reason to suppose that Moessnang incorporates, teaches, or implies anything about those subjects. Had the prior art considered such subjects pertinent to boom furling art, **Moessnang's omission of them** would have resulted in **denial** of the patent.

MOESSNANG'S DETEAILED LUFF SPECIFICATION HAD SPECIFIC IDENTIFYING NUMBERS.

MOESSNANG'S MAINSAIL LEECH HAD NO SPECIFIC IDENTIFYING NUMBER WHATEVER.

Not only does Figure 5 of Moessnang assign the number 27 to the luff of the depicted mainsail, but it goes further, assigning specific numbers to the physical components of luff 27, namely: boltrope 72, luff tape 74 and even assigns a specification for the boltrope: "in the illustrated embodiment the boltrope 72 is manufactured of polyurethane having a Shore hardness of 90 in the extrusion method. It has turned out that this combination of materials has an optimum stability. (p. 7, lines 12-26).

Moessnang **could have** assigned a number to the leech of the sail depicted in its drawings. It did not. Moessnang **could have** specified a reinforcing tape at the sail's leech to assure the <u>optimum stability and durability of the leech area of the sail</u>, as is <u>invariabl</u>y furling boom sail making manuals invariably specify Moessnang disclosed no such specification.

Clearly, Moessnang's failure to address the aft end of the depicted sail was **intentional.** The aft end of the sail was irrelevant to Moessnang's claims. As in Marechal, the leech of the Moessnang mainsail could have been omitted entirely from the drawings without affecting the subject matter of the patent or the ability of one skilled in the art to make and use the invention.

At page 9, line 4, Moessnang assigned the number 27 to the mainsail. No number is assigned to the sail's leech. Reference to the sail's leech appears in a context of stress paths at page 9, line 10:

"the direction B (FIG. 7) applied via the leech by the sheet tension..."

In fact, the force controlled by sheet tension is transmitted along the sail's straight clew-to-head line, not along its convex curved leech. In yet another aspect, the sail's roach is irrelevant for purposes of Moessnang.

Moessnang's vague description of its mainsail in no way anticipates or teaches whether an overlapping mainsail would be feasible for conventionally rigged sailboats, or whether predetermined parameters for such mainsails would be feasible.

"...the mainsail **<u>can</u>** (emphasis supplied) have a roach, **<u>especially in the top area</u>**." (p1, line 43).

In reciting explicitly that **roach was optional**, and that **roach need not be evenly distributed** along the length of a sail's leech, <u>Moessnang specifically excludes from its pertinent subject matter the back end of a sail and a regularly distributed elliptical leech curve:</u>

1. <u>Necessarily</u>, a semi-elliptical sail that overlapped its companion permanent backstay would have an <u>evenly distributed</u> roach, **but**
2. Moessnang explicitly stated that its mainsail did not need any roach at all. Thus, the Moessnang mainsail leech curve could have had a linear, concave, or even convex profile. The back end of the Moessnang mainsail and its relation to a boat's rig was entirely outside the subject matter of Moessnang or the prior art it referenced.

3. The text of **Moessnang** recited that back end of a sail could have any form whatever. The Moessnang drawings depict a sail with an arbitrary shape that bears no relation to a boat's rig or an elliptical leech curve. The description of drawings refers to a boat's rig, but only a mast is shown. The patent's "top heavy" roach description is mutually exclusive of an evenly distributed elliptical leech curve. **Moessnang could not possibly have taught or inferred anything concerning a semi-elliptical mainsail with a roach that overlapped a boat's permanent backstay.**

Furthermore, Marechal and Moessnang both disclosed a mainsail that needed neither battens nor roach for purposes of their respective claims. Accordingly, neither patent nor the referenced prior art could possibly have taught or inferred anything concerning an overlapping semi-elliptical mainsail, which, by definition, has a roach. Thus, neither Marechal nor Moessnang related in any way to predetermined maximum roach overlap parameters, elliptical leech curves or rig overlap. Rather, the specific language of those patents is pertinent to none of those sail properties.

MAINSAIL "1`" OF MOESSNANG IS AN ARBITRARY ARTISTS CONCEPTION THAT RELATES ONLY TO THE FRONT END OF A MAINSAIL.

Moessnang referred to only one mainsail, assigning to it the identifying number 1, yet drawings **1a, 1b, 2a, 6, and 7** show diverse mainsails, each having a different, arbitrary back end. No identifying number for a leech appears anywhere in Moessnang. In fact, the only parts of a mainsail that Moessnang does identify specifically are its boltrope 72 and its headboard 24.

The issuance of Marechal and Moessnang establishes that maximum roach parameters, elliptical leech curves and rig compatibility were extraneous to the subject matter of those two patents. The pertinent prior art teaches or suggests nothing about such subjects. Pursuant to the foregoing analysis, it may be concluded that neither Marechal, nor Moessnang, nor the prior art pertinent to either teach or suggest anything concerning the back end of a sail.

RIGID BOOM PRIOR ART REVEALS NOTHING ABOUT PREDETERMINED PARAMETERS FOR SPECIFIC LEECH SHAPE OR RIG OVERLAP

US Patent 5,463,969 to Hoyt (1995) covered a pedestal-mounted, curved rigid boom that rotated in only a horizontal plane, as opposed to known designs that had both a vertical and a horizontal articulation. The patent is notable in that it teaches nothing about leech parameters or rig overlap, and that it issued for a small variation on a well-known device.

Pedestal-mounted booms, and socket-mounted "balestron" booms similar to the Hoyt boom are well-known devices that had fallen into disuse by the time the Hoyt boom appeared. Accordingly, a possibility for commercial revival of an outdated device may have influenced patentability in Hoyt. In addition, since the Hoyt boom was compatible with furling sails, it could benefit from their long-established market success.

Hoyt identified its sail's luff "42", but did not identify its sail's leech. The sail depicted in Figure1 is an artist's conception of a small boat mainsail with partial, not full battens. Neither the patent's text nor its drawings in any way address a sail's leech curve. Since the patent describes a sailboat that has no rigging, its subject matter necessarily discloses nothing pertinent to rig overlap or the back end of a sail. Figure 4 of Hoyt **omits** every part of a sail except its lower forward corner, yet the patent issued. As in Bierig, Marechal, and Moessnang, Hoyt ignored entirely the back end of its sail; so much so that Hoyt's Figure 4 does not even bother to depict the back end of the sail.

BIERIG, HOYT, MARECHAL, AND MOESSNANG, EACH PRESENTED A SMALL VARIATION OF A WELL KNOWN DEVICE IN A CROWDED CLASSIFICATION.

The abovementioned patents have the following common denominators:

1. Each issued in a crowded classification;

1. The claimed inventions differed only slightly from well known counterparts;

2. Each issued subsequent to widespread acceptance of convenience and safety-oriented roller furling configurations;

3. Each covered an outdated device that had fallen into disuse: rudimentary around-the–boom mainsail furling booms in the case of Marechal and Moessnang; symmetrical rigid wishbone spars in the case of Bierig; and pedestal-mounted jib booms in the case of Hoyt;

Although Bierig, Marechal, Moessnang, and Hoyt presented solutions to long-standing problems; those solutions were only minor variations on known devices and concepts. Nonetheless, patents did issue in each case, illustrating the patentability of relatively minor advances in a crowded classification.

Bierig, Marechal, Moessnang, and Hoyt each occupied a crowded rigid external spar classification that is distinct from the sail-power subject matter of the System. Notwithstanding, the present application presents patentability aspects similar to those underlying issuance in the above rigid spar patents:

In addition, the market context of the present cause resembles that which preceded issuance of the abovementioned rigid spar patents:

1. **Increasing and ongoing acceptance of convenience and safety-oriented sail control devices**: mainsail and headsail furling configurations already dominated the market despite compromised performance;

2. **Ongoing but unsatisfied demand for an unavailable product**; No available working sail configuration enabled optimum convenience and safety as well as optimum performance;

3. **Replacements for outdated devices and concepts are unavailable**: underpowered triangular working jibs and rigid external jib spars had fallen into disuse despite the convenience and safety advantages of self-tacking jib configurations; and

4. **The present application addresses a crowded classification**. Far beyond the minor advances of the abovementioned rigid spar patents, Applicant's System introduced major advances in the art of sail power in contrast to minor variations on well known rigid boom devices.

THE SYSTEM'S SUBJECT MATTER DIAMETRICALLY OPPOSES RIGID SPAR PATENTS

AND INTRODUCES MAJOR ADVANCES IN THE ART OF SAIL POWER

By definition, rigid spar patents pertain to rigid spars. In sharp contrast, the System addresses a comprehensive sail power system that **eliminates** rigid spars. Furthermore, the System introduces major advances in a crowded classification including:

1. Universally compatible, low-cost Optimized working sails that imposed no modification to boat or rig;

2. Predetermined maximum roach overlap parameters;

3. Self-boomed sails made from presently available sailcloth and battens; new combinations and uses of known materials and methods that enabled reduced batten weight and even batten-free sails; and

4. Overlapping self-tacking sails.

OBJECTS AND ADVANTAGES OF THE SYSTEM

ADVANTAGES OF OPTIMIZED HOISTED WORKING SAILS OVER TRIANGULAR WORKING SAILS:

1. Savings to boat buyers and greater profits to sail makers and boat builders.
2. 30% more sail area and 15% less heel on average;
3. Unique, unexpected overlapping self-tacking headsails that deliver both optimum performance and optimum convenience across a wide range of conditions.
4. A single self-tacking sheet replaces alternately tensioned port and starboard headsail sheets
5. A self-tacking sail replaces hard-to-handle long-footed genoas.
6. Two Optimized cockpit-controlled self-tacking working sails eliminate on deck sail handling, below-deck sail stowage, and costly sail inventories;
7. Rigid external spars give way to self-boomed sails;
8. Ideal working sail interface;
9. Low initial cost, no special equipment, no modification to boat or rig; and
10. An unexpected cost-effective performance alternative to taller masts, free flying sails and high crew risk and effort.

ADVANTAGES OF SELF-BOOMED SYSTEM SAILS: OPTIMUM CONVENIENCE AND SAFETY

1. Self-tacking jib convenience combined with overlapping elliptical sail area creates new-user markets while satisfying existing demands;
2. Increased power over small triangular jibs enabling truly versatile self-tacking working sails without resort to costly, heavy furling genoa configurations and hard-to-handle, free flying sails.
3. Elimination of heavy, rigid jib spars for optimum safety and convenience;
4. New combinations of diagonal battens and vertical deployment control lines enable cockpit-controlled deployment, single-line reefing, and recovery of **hoisted** headsails and mainsails.
5. Automatic increase in self-booming rigidity as sail is reefed;
6. Lightweight, integral booming, vanging, deployment, reefing, and downhaul functions;
7. Dynamic sail response to changing conditions;
8. Stable at unstable downwind sailing angles where triangular sails are unstable;
9. Small incremental cost over triangular working jibs.

ADVANTAGES OF SELF-BOOMED SYSTEM SAILS: OPTIMUM PERFORMANCE

1. One specific **performance** objective was to get a maximum of efficient sail area as high as possible without changing a boat's rig. Unexpectedly, the resulting mainsails enabled and complemented more easily handled, task-specific headsails;
2. Self-boomed working sails with sufficient combined area can serve as an effective, easily controlled alternative to hard-to-handle free-flying headsails, and
3. Stable, powerful working sails can produce average speeds for shorthanded boats that equal or better those promised by long-footed genoas and free-flying headsails.

"**Many sailors don't want to exert themselves sheeting in large headsails.** During last fall's boat shows we couldn't help but notice the number of boats offered standard with self-tacking jibs...A modern boat can sail quite nicely with a large mainsail and [100%] working jib" (Practical Sailor, May 15, 2000).

The foregoing confirms that owners would increasingly choose self-tacking jibs if only performance and safety compromises could be eliminated. The System eliminates those compromises, resolving problems designers have failed to address, let alone solve.

ADVANTAGES OF SELF-BOOMED SYSTEM SAILS: OPTIMUM CONVENIENCE

System **convenience** objectives were 100% cockpit control of self-tacking Optimized working sails without resort to rigid external spars or costly, heavy furling configurations. Reducing those objectives to practice enabled unprecedented economies for boat builders and buyers alike.

A NEW, UNEXPECTED SELF-TACKING SAIL TYPE

As opposed to a convenient self-tacking headsail, a hoisted overlapping genoa inevitably imposes port and starboard sheets, high effort tacking and jibing, and dangerous on-deck sail changes. According to the entire history of sail design, "overlapping" sails simply could not be "self-tacking",

Choosing to ignore this dictum, Applicant closely observed and compared the tacking and jibing cycles of overlapping sails with port and starboard sheets as well as those of sails with only a single self-tacking sheet. These comparisons led to a concept for sails with a non-overlapping foot and an overlapping upper section. The method and the results were diametrically opposed to long-established design approaches. Reducing that concept to practice was anything but obvious. The unexpected results had theretofore been unimaginable.

WHY OVERLAPPING SELF-TACKING HOISTED SAILS WERE UNIMAGIINABLE

RESTORING ORDER TO MISUSED TERMINOLOGY

Sail makers and boat builders have inextricably linked the term "self-tacking" with the term "jib", and the term "overlapping" with the term "genoa". Thus ensued the assumption that a self-tacking jib, as opposed to an overlapping genoa, could not overlap any of a boat's rig elements. While apparently sound, that assumption is invalid.

To restore order: **"Self-tacking"** is a term that describes the **movement** or function of **only the clew of a sail**, without regard to whether any other part of the sail overlaps a companion boat's mast or rigging. **Overlapping"** describes a **static physical relationship** between a sail's leech and companion rig elements.

Despite prevailing assumptions to the contrary, if clew of a sail passes clear of companion rig elements, there should be no reason to assume that the upper part of the sail could not tack and jibe safely and reliably, controlled by a single self-tacking sheet. It remained for Applicant to develop predetermined parameters that assured consistent passage of a self-tacking sail's leech across rig elements when tacking and jibing.

OVERLAPPING SELF-TACKING SAILS: CONTRADICTION OR SYNEREGISM?

In functional terms, designers might have asked, "Can a headsail have both light air power and self - tacking convenience?" or, "Can an overlapping headsail comprise a self-tacking function?" Designers never posed such questions because such questions would have been considered absurd. Had a designer dared to air such a question, glib answers might well have included, "genoas can't self-tack, and pigs can't fly."

1. Applicant's Maxmain prototype tests proved that an Optimized overlapping mainsail not only tacked and jibe reliably and safely across a companion permanent backstay, but that the sail-backstay interaction significantly **enhanced** the test boat's speed through tacks and jibes.

2. The test boat's Optimized Maxmain crossed its companion permanent backstay sequentially, beginning with an initial Maxmain rig contact point **82**, proceeding to roll across the backstay until the backstay momentarily held the head of the sail "aback". Historically, holding a sail aback required that crew delay releasing the tensioned, or "old" sheet until the boat passed through the axis of the wind, at which time crew must quickly release the old sheet and tension the "new" sheet. This maneuver was possible **only** for headsails with separate port and starboard sheets.

3. A self-tacking sail that could **automatically** remain aback just long enough to accelerate a boat through the axis of the wind had never even been considered. Maxmains achieved precisely that inconceivable result, **remaining aback automatically,** and then completing the tack or jibe automatically **without crew intervention,** and with a release of energy that enhanced speed through the end of the maneuver. An overlapping Maxjib should tack across the large, smooth radius of a companion mast even easier than the test boat's prototype Maxmains tacked across the boat's permanent backstay.

UNEXPECTED SINGLE-LINE REEFING RESULTS

1. Unexpectedly, semi-rigid battens enabled System objectives that **Bierig** had deemed unfeasible. Mr. Bierig and other designers never imagined that semi-rigid battens could self-boom a sail, let alone resist the inward forces imposed by a reef line. Nonetheless, the System's unique diagonal semi-rigid batten layouts produced precisely what those designers had uniformly ignored. The result was produced by an **unexpected batten triangulation.**

2. As a self-boomed Maxjib is lowered for reefing, its bottom, upwards-oriented diagonal batten descends along its diagonal forestay until it **assumes a horizontal attitude**. At this point, the now-horizontal bottom batten constitutes the base of a triangle whose two other sides are the sail's second diagonal batten and its companion forestay. This triangulation significantly reinforces the sail's resistance to inward reef line forces.

3. Going beyond the unexpected self-booming result, this triangulation enables optimum sail shape and dynamic sail response to a wide range of wind and wave conditions that a sail set from a rigid external spar cannot provide. Self-boomed System sails **respond dynamically to changing conditions while holding a sail's foot in horizontal extension** through a wind-speed range from five to thirty-five knots. Unlike boom-attached sails, self-boomed System sails can move, or "breathe" in response to changing conditions.

4. Similarly, as a self-boomed Maxmain is lowered for reefing, a triangle forms between its stationary downwards-oriented, bottom diagonal batten; its first parallel batten; and its companion mast. If more than one reef point is present, subsequently lowered horizontal battens progressively reinforce the reef-configuration triangle to meet increasing wind speeds.

5. Progressive reinforcement of a System sail's reef triangulation **unexpectedly enabled** lighter-than-anticipated battens, which reduced weight aloft and also improved light air performance and ease of tacking and jibing. This effect would be extended by use of batten reduction and batten substitute technology.

6. Finally, self-boomed System sails displayed optimum shape and durability over an extended test period in a wide range of wind and sea conditions with no batten breakage or unusual sail wear whatever

UNEXPECTED ECONOMIC RESULTS

Figure 6 superimposes two working sail configurations having equal sail area:

1. Optimized Maxmain **30** and overlapping Maxjib **26** fitted to a "standard" height mast; and
2. An "optional" tall rig configuration **113** comprising a taller triangular mainsail **112** and triangular jib **111** fitted to a taller mast.
3. As seen below, batten reduction and batten substitute technology can reduce manufacturing costs for furling boom manufacturers as well as sail shipping and storage costs for users and sail makers alike.
4. Achieving triangular sail area equivalent to that of the Optimized sail configuration shown in **Figure 6** required a 20% increase in mast height. Comparative costs appear below for a tall rig as a new boat options for a 35-foot, "reference boat," costing $200,000 new, and for an aftermarket or "retrofit" modification to a used reference boat.

TALL RIG EFFECT ON BOAT STABILITY AND PERFORMANCE

1. For counterpart boats, a standard-height mast setting System Maxmain and Maxjib would undoubtedly enable equal or greater average boat speed than a tall rig setting conventional sails. In addition, the standard-height mast setting System sails would impose less crew effort and risk.
2. The effect of increased mast height on boat stability can be mitigated somewhat by using a more expensive, but lighter carbon fiber one. In all cases, longer, heavier rigging wires are required; adding weight aloft, which negatively affects stability. Finally, increasing the weight and length of the lever above the water typically **increases heel and requires earlier reefing.** Contrarily, **System sails reduce heel, thus enabling delayed reefing** despite their increased sail area.

OPTIMIZED SAIL COST COMPARED TO TALL-RIG COST

1. Depending on whether an aluminum or carbon fiber mast were chosen, in **cost terms**, a tall rig option for a new reference boat would add $15,000 -$30,000 to new boat cost. **Retrofitting** a tall rig to a used reference boat would cost approximately $17,500 for an aluminum mast and $35,000 for a carbon fiber mast, **not including** labor costs, not including the time value of the period the boat was immobilized, and not including conventional counterpart tall rig sails costing approximately $4300.

Consequently, average cost for an optional tall rig for a **new**, reference boat would be approximately **<u>$27,5000</u>**. Average cost to **retrofit** a tall rig to a used reference boat, including new hoisted mainsail and roller furling genoa would be approximately $32,000 plus labor and the time value of the period during which the boat was immobilized.

2. A System Maxmain and Maxjib having tall-rig-equivalent –sail-area would add a **<u>$1200 increment</u>** over the cost of conventional sails for the standard-height mast, or 4% of the cost of a tall rig. Truly versatile System sails impose no modification to boat or rig, they involve no installation cost, and they reduce heel by 15%, delivering optimum boat speed with minimum crew intervention.

3. In **<u>percentage terms</u>**, fitting an Optimized Maxmain and Maxjib to a reference boat having a standard-height mast would increase the reference boat's sail area by 30% **for less than <u>1%</u>** of new boat cost. While a tall-rig retrofit with conventional mainsail and furling genoa could provide a similar increase in surface area, minimum cost would be 20% to 30% of the price of a new reference boat. Naturally, the **30-to-one percentage–of-cost advantage** of System sails over tall rig conversions would increase significantly in the case of a used reference boat, according to its age and condition.

4. Where System sails are an easily installed, highly cost-effective performance product, **tall rigs are not cost-effective, either as new boat options or retrofits.**

5. In **<u>marketing terms</u>**, a $1200 increment to the cost of a $200,000 boat amounts to a "must have" item for a boat owner looking at a $30,000 cost for a tall rig conversion that cannot deliver equivalent performance or convenience advantages for a shorthanded boat. To the owner of a used reference boat worth, for example, $120,000, the cost-to-performance ration weights a choice for System sails over tall rig even further.

<u>TALL RIG VERSUS OPTIMIZED SAILS: SUMMARY</u>In summary, a boat with Optimized sails fitted to a standard-height mast would be lighter than one with a tall rig, would heel 15% less, and would go as fast or faster than the tall rig counterpart with less crew effort and risk. A 1% or $1200 increment to new boat price would yield 30% more sail area and greater sail efficiency, plus increased safety and comfort. Clearly, simply-installed System sails that equal or better tall-rig-performance would be highly attractive and marketable at **<u>less than 5% of the cost of a tall rig.</u>**

<u>UNEXPECTED CONVENIENCE AND SAFETY RESULTS</u>

1. Surprisingly, reefing or recovering prototype hoisted Maxjibs proved easier than furling the test boat's genoa, particularly in heavier wind conditions. The test boat's twin-headstay configuration enabled direct comparison of a hoisted Maxjib and various furling genoas.

2. Gravity and the Maxjib downhaul line invariably helped lower or reef the 100% cockpit-controlled, hoisted Maxjib in all conditions. Natural forces in no way aided the furling genoa. The harder the wind blows, the more difficult the furling process, and the greater the possibility of problems with the furling mechanism, the furling line or the sail, itself. If a problem arises in heavy weather, a partially furled headsail that cannot be lowered. At that point an dangerous situation is at hand.

3. Reefing or lowering a hoisted Maxjib in heavy weather actually produced less anxiety and required less effort than furling a supposedly safer and more convenient roller furling counterpart in like conditions.

4. As for light air conditions, if supplementary free flying sails are used, even furling ones, crewmembers must go forward frequently to lower and stow such sails and set or strike a spinnaker pole if one is used. Upwind or downwind, a hoisted Maxmain and Maxjib provide appropriate self-boomed sail area while causing the least possible heel, and eliminating on-deck sail handling.

5. Ironically, cases will undoubtedly arise where a boat owner might elect to separate the performance benefits of elliptical sail form yet still access the System's convenience and safety properties, or vice versa. System design accommodates such demands.

6. For example, the owner of a traditional sailboat might wish to retain a traditional triangular sail profile for aesthetic reasons but still enjoy the convenience benefits of a comprehensive System control configuration. Such an election sacrifices performance but would cost somewhat less than a full System configuration.

7. Conversely, a performance-oriented boat owner who sails with a full complement of skilled crewmembers might wish to forego the convenience of comprehensive System cockpit control, thus limiting his sail configuration to a System batten layout and leech curve conforming to universal System maximum roach parameters As above, such an election sacrifices convenience but would cost somewhat less than a full System configuration.

8. The two foregoing applications of System properties are **unexpected** in that Applicant envisioned applications demanding an integration of optimum performance and optimum convenience and safety. In fact, the design fusion of System properties is divisible to advantageously satisfy particular marketing requirements.

9. **System solutions** thus filter through, either separately or jointly, to meet the needs of the entire spectrum of boat-owners. Applicant tailored the System for shorthanded boats, yet System configurations meet the needs of fully crewed race boats as well those of boats that opt for traditional sail profile.

10. The unexpected breadth of the System's marketing potential attests to the fact that the System presents unprecedented solutions to a diversity of performance, convenience, and safety demands; **solutions that were heretofore unavailable and, indeed, unforeseeable.**

STEP-BY-STEP DEVELOPMENT PROCESS

A sail controlled by a single sheet provides "hands-off" self-tacking because its sheet and clew do not contact rig elements when the sail tacks or jibes. Thus, self-tacking prerequisites do not preclude rig contact by the upper part of a sail. Applicant's extensive prototype testing established that a combination of an overlapping upper leech and a non-overlapping clew and sheet tacked and jibed reliably and safely. Applicant next sought to develop predetermined maximum parameters that would make the discovery universally applicable to mainsails and self-tacking headsails alike. The eventual product would be a new sail type that eliminated external spars, using semi-rigid batten layouts that would unexpectedly enable self-boomed, self-tacking overlapping headsails and mainsails.

REDUCTION OF THEORY TO PRACTICE

Once wind fills a sail, its cambered three-dimensional profile is "narrower" than its flat, two-dimensional profile might suggest. In operation, the test boat's Maxmain contacts companion permanent backstay **18** without violence, then "rolls" across the backstay from initial Maxmain rig contact point **82** upwards. Crossing last, the sail's head **98** pauses "aback" momentarily, complementing the momentum of the boat as it turns toward the axis of the wind. As sail's head finally crosses the backstay, a release of energy **automatically** accelerates the test boat through the axis of the wind. Thousands of successful tacking and jibing maneuvers with overlapping Maxmain prototypes confirm this unexpected phenomenon.

1. Applicant's Maxmain backstay-batten deflection tests should apply equally to overlapping Maxjib **26**. With each tack or jibe, an overlapping maxmain would cross mast **10**, which has a large, smooth radius, and forward lower shrouds **16,** which incline inwards. Those rig elements should

prove significantly less obstructive to tacking and jibing an overlapping leech than a permanent backstay consisting of a rigging wire having a far smaller radius and no favorable inclination.

2. Predetermined maximum roach parameters for each System sail are based on embodiment-specific, rig-element-related reference points. Basing roach calculations on a measurement taken from the sail, itself, such as "E" cannot provide sailmakers with functional, predictable roach overlap guidance. An overlapping sail must clear companion rig elements, not itself.

3. Applicant's predetermined maximum roach parameters generate leech limit points **96** that insure maximum functional sail area and an elliptical leech for each System sail, regardless of a boat's rig configuration.

APPARENT DESIGN OBSTACLES

Applicant encountered seemingly insurmountable design problems:

1. Could a hoisted, overlapping self-tacking headsails be universally compatible with conventionally rigged sailboats? Since the terms "overlapping" and "self-tacking" had always been considered contradictory, the obvious answer was, "no."

2. Could a relatively small hoisted, self-tacking headsail for heavier conditions somehow become a "big", overlapping headsail yet still tack and jibe automatically? The obvious answer was, "no."

3. Could predetermined maximum roach overlap parameters enable large roach overlapping mainsails for conventionally rigged sailboats with permanent backstays? The obvious answer had always been, "no."

Transcending those problems was anything but obvious. The relatively small sail area and inefficiency of triangular working sails and persistent assumptions that perpetuated the role of triangular working sails were virtually inescapable facts of life.

> "From the perspective of induced drag, the worst shape for an airfoil is a triangle, [which is] the shape of a headsail and, to a lesser extent a main (Whidden, The Art and Science of Sails, St. Martin's Press (1990).

UNEXPECTED THEORETICAL CONCLUSIONS REDUCED TO PRACTICE

Reducing Optimized working sails to practice demanded predetermined maximum roach overlap parameters that at once assured maximum sail area and consistent tacking and jibing without unusual sail wear in actual sailing conditions. Low wind speeds presented the greatest problem because a sail might not have sufficient momentum to tack or jibe across companion rig elements.

Applicant developed and reduced to practice predetermined maximum roach parameters for overlapping, self-tacking System sails that tacked and jibed reliably without unusual sail wear, even at winds speeds as low as three knots. **Hoisted** System sails introduced an unprecedented combination of attributes:

1. Adequate sail area for truly light conditions of 3-5 knot wind speeds.
2. Reliable tacking and jibing in wind speeds as low as three knots.
3. Integrated cockpit controlled deployment, recovery, and single-line reefing functions.
4. Single-line reefing without resort to a rigid external spar.
5. 30% more sail are than triangular counterparts.
6. Overlapping semi-elliptical performance combined with hoisted sail economy and safety.
7. Convenience equal or better than that of furling configurations.

SPECIFIC PROTOTYPE TEST RESULTS: SUMMARY

1. The test boat's prototype non-overlapping Maxjib **28** and external-spar Maxmain **32**, had approximately 30% more surface area than triangular counterparts and tacked and jibed reliably in all wind conditions. Entirely cockpit-controlled, the sails increased test boat's speed by fifteen-percent and reduced heeling by five degrees, or thirty-percent.
2. The Maxjib's diagonal batten layout provided lightweight, low cost self-booming and vanging.
3. Cockpit-controlled sail-deployment, reefing, and recovery reduced effort and anxiety levels.
4. The test boat's overlapping mainsail easily tacked and jibed across the boat's permanent backstay in winds as low as three knots.

4. Applicant's predetermined maximum roach parameters proved reliable through a series of prototype Maxmains, proving the feasibility of such parameters for series boat builders and sailmakers.

PROTOTYPE TEST RESULTS LEAD TO UNEXPECTED NEW SAIL TYPES

Prototype tests proved that new semi-rigid batten layouts could support an Optimized sail's roach while providing self-booming. Those batten configurations combined with innovative batten and luff connection configurations enabled self-boomed designs for Maxmain **30,** overlapping Maxjib **28**, and non-overlapping Maxjib **28** as well as one for external spar Maxmain **32**, each producing new, unexpected results.

UNEXPECTED NEW SAIL TYPES SUGGEST NEW BATTEN AND SAILCLOTH USES

"Batten substitute technology", an alternate embodiment of the System, enables lighter battens or even batten-free construction for semi-elliptical sail System sail embodiments. Thus lightening sail weight aloft further extends System sail advantages.

ALTERNATE EMBODIMENT: EXTERNAL BATTEN REDUCTION TECHNOLOGY: OVERVIEW

The mainstream sail market is less receptive to reduced sail weight than the racing market. For the mainstream market, sail-weight-reduction must be attractively priced and must not compromise sail life. Lightweight but costly carbon fiber battens, for example, would have little, if any, mainstream market potential. Mainstream sail buyers still prefer heavier Dacron ™ sails to less durable but lighter sails made of exotic, expensive materials such as Kevlar™.

Using presently available technology such as Dacron™ sailcloth, the System introduces cost-effective reduction of weight aloft while enhancing the tacking and jibing of overlapping sails. Synergism is seen in the following:

External batten reduction technology, applicable to any sail, would combine a smaller, lighter-than-usual flat or round conventional batten and a task-specific, **high-density batten reduction sleeve 37** in place of a larger, heavier conventional batten pocket and batten. An example of external batten reduction technology is seen in **Figures 11, and 11a**:

Figure 11a shows a smaller-than-usual conventional fiberglass batten in combination with a correspondingly smaller, task-specific high-density batten reduction sleeve **37**. Such a **batten reduction combination** could achieve weight reduction at a lower cost than, for example, a lighter but stiffer carbon fiber batten, which would impede tacking and jibing an overlapping sail.

Task-specific high-density batten reduction sleeves **37**, as more fully described below, could be made from sewn or laminated combinations of <u>available sailcloth</u> having fabric orientation such as that seen in **Figure 11a**. Batten reduction sleeves can also have **external variable density batten sleeve zones 37a** situated at rig contact points that would optimize tacking and jibing.

Alternatively, such external batten reduction sleeves could be fabricated using existing fiber-orienting-sail-making-technology to create design-specific local fiber orientation and densities. They could then be attached to panel-cut, or even fiber-oriented laminated sails. Fiber orientation technology, which is the most costly sail construction method, could be used to effect reduced sail weight for less expensive, panel-cut sails.

Manufacture of such batten reduction sleeves is a new and unanticipated use of fiber-orientated sail making technology that would generate unexpected new sail making products and revenues. Such batten reduction sleeves would be easily transportable in large quantities and could carry high profit margins. Each such batten reduction sleeve could additionally incorporate a low-friction outer skin to further facilitate tacking and jibing.

Figure 11a also shows a semi-rigid batten having a **variable density batten zone 37d.** Reducing the thickness of a batten in a zone proximate a to rig contact point could further facilitate reliable tacking and jibing without detracting from a batten's ability to maintain sail shape. Such reduction in an intermediate zone of a batten rather than at its extremity is, in itself, a new use of a conventional batten. Battens with variable density zones can be manufactured using existing technology. The combination of a high density batten reduction sleeve and a variable density batten zone is a new one, and the combination leads to an unexpected result: significantly lighter overlapping headsails and mainsails that tack and jibe safely and reliably across the rig elements of any conventionally rigged sailboat.

<u>ALTERNATE EMBODIMENT: INTEGRAL BATTEN SUBSTITUTE TECHNOLOGY</u>

BATTEN-FREE SAILS: OVERVIEW

Figure 11b illustrates how a **new use** of existing fiber orienting technology could be used to eliminate battens and batten pockets entirely. Sails made with integral batten substitutes would have a self-supporting roach. This unanticipated result deriving from a new use of fiber orienting sail making technology would combine specific densities and orientations of horizontal fibers and "diagonal or vertical" fibers along each batten-substitute axis. Each such combination, or **integral batten-substitute 37b,** would replace a corresponding batten and pocket.

Placement of task-specific integral variable density zones **37c** at rig contact and sail-folding points would enable batten substitutes to deform and recover their original configuration, thus facilitating sail maneuvers as well as sail folding. The specifics of both external batten reductions and integral batten substitutes are set forth immediately below.

HOW TO MAKE A SAIL WITH EXTERNAL BATTEN REDUCTION TECHONOLOGY:

Figures 11 and 11a show a **self-boomed Maxmain 30** in a partial side view, and in an exploded side view, respectively. The batten shown in **figure 11a** represents a 10-millimeter-wide flat fiberglass batten, which has replaced a 20-millimeter-wide counterpart. A correspondingly smaller, lighter, closed end, task-specific **high-density batten reduction sleeve 37** contains the 10-millimeter batten. That relatively lighter batten can further enhance tacking and jibing if it comprises a **variable density batten zone 37d** proximate to a rig contact point, as seen in **Figure 11a.** A high-density batten sleeve in combination with a batten having a rig-contact-zone-reduction 15% should produce optimum tacking and jibing across rig elements without prejudicing sail shape.

The combination would provide adequate roach support while reducing sail weight. In the case of a hoisted mainsail fitted to a furling boom, furled sail volume is a critical consideration. Reducing the volume of a furling boom's companion sail allows a single boom size to accommodate a larger range of sail sizes as opposed to having an expanded range of boom sizes to accomplish the same end.

Unexpectedly, an **economical** combination of new batten and batten pocket configurations reduces sail volume for boom-furled sails where formerly, **expensive** tri-radial sail construction and costly, less durable sail cloth were the only means to reducing sail volume.

Task specific high-density batten sleeves and variable density batten zones would be located and oriented according to a sail's design and could incorporate a low-friction outer skin in areas of rig contact to further facilitate tacking and jibing. **External variable density batten sleeve zones 37a** could also be situated to facilitate rolling or folding a sail.

SURPRISING ADVANTAGES: EXTERNAL BATTEN REDUCTION COMBINATIONS

Violent contact between a heavy, rigid external boom and rig elements can break a boom or even worse, sever rigging, perhaps dismasting a boat in the case of a violent accidental jibe. A semi-rigid batten transmits minimal shock as it contacts a rig element, even in the case of an accidental jibe. The self-boomed configurations shown in **Figures 11a and 11b** would transmit less shock than rigid spar counterparts and would be less susceptible to damage. **External variable density batten sleeve zones 37a** would further mitigate rig contact impact. In no event would a semi-rigid batten menace a boat's rig elements.

Reducing sail volume without resort to costly, exotic sail materials and sail construction methods is yet another unexpected result of batten reduction and batten substitute technology. For example, furling boom manufacturers frequently specify maximum luff lengths that furl into their booms only under perfect conditions, leaving no room for crew error or difficult weather conditions. A furling boom for even a small boat such as Applicant's test boat typically costs over $5,000.

Boat owners will not willingly abandon a boom and change it for another one if the boom cannot safely furl the volume of a companion sail in all conditions. On the other hand, a mainsail that cannot be furled easily in all conditions poses an unacceptable risk. As an example, the manufacturer of Applicant's furling boom specified a maximum luff length of eleven meters. The boom was incapable of furling ten meters of luff length. The manufacturer increased the capacity of later boom versions to correct the deficiency.

Failing a change of boom, a boat owner can attempt to "make do" with an undersized furling boom by discarding his existing sail and replacing it with one made with expensive tri-radial construction and marginally thinner exotic sailcloth such as a Kevlar™-based laminations. In such cases, any reduction in sail volume is likely to be inadequate. In the final analysis, a typical boat owner will be unwilling to discard a perfectly good sail and buy a more costly one made from exotic sail cloth that is typically less durable than his existing sail.

Thus far, furling booms have failed to reach a wider market because they require a high level of operator skill as a sail is furled down into a boom. Batten reduction and substitute technology offers a solution to the foregoing problem in many cases while a reduction in a sail's volume and weight reduces the effort required to handle it and more importantly, extends the margin for crew error in furling the sail.

System sails that integrate batten reduction or batten substitute configurations can be of economical panel-cut Dacron™ construction yet still assure reduced sail volume for furling boom applications. For furling boom manufacturers and resellers batten reduction and batten substitute technology enable a smaller range of boom sizes as opposed to a more diverse range, greatly reducing manufacturing, storage, and shipping costs.

MAKING A BATTEN-FREE SAIL WITH INTEGRAL BATTEN-SUBSTITUTE TECHNOLOGY

Figure 11b is an exploded partial side view of a batten-free sail constructed made with existing fiber orienting technology. The combination comprises:

1. Synthetic sail making fibers such as Dacron ™ locally laminated along horizontal paths, thus substituting in part for semi-rigid battens; and
2. "Diagonal or vertical", task-specific laminations of synthetic sail making fibers such as Dacron ™ laminated in combination with the horizontal fibers to complement their rigidity. The diagonal fibers shown In **Figures 11a** have areas of reduced density near backstay contact points, constituting **external variable density batten sleeve zones 37a.**

For purposes of illustration, only diagonal fibers have been depicted in **Figure 11b**. A basic or reference density ratio of approximately **two diagonal** or vertical fibers **to one horizontal fiber** should provide roach support while allowing the folding of a sail for stowage or transport. The combined rigidity

of an external batten reduction sleeve and its companion batten should be roughly equivalent to that of the batten the combination replaces.

With the foregoing "reference density" as a point of departure, densities for external variable density batten sleeve zones **37a** would be derived as follows:

1. In variable density zones, "vertical or diagonal" fiber density would be approximately **85% of reference density**, and horizontal fiber density would be approximately **70% of reference density**. Those lamination densities should ensure roach support while facilitating tacking, jibing, and folding a sail for storage or shipment.

2. In variable density zones, high-density "diagonal or vertical" fibers would separate, or "deform" upon rig contact or sail folding by virtue of locally reduced density, then return to their original configuration as intermittent loading decreased. Similarly, horizontal fibers would yield upon rig contact or folding then return to original configuration as point loading decreased. The aggregate deformation should enable tacking and jibing a batten-free sail as well as folding it.

EXTERNAL AND INTEGRAL BATTEN SUBSTITUTE TECHNOLOGY IN OPERATION

A **high-density external batten reduction sleeve 37a** would present no obstacle to tacking, jibing, or sail folding once its batten was removed. Folding instructions for each System sail would explain folding procedures based on permanently marked variable density zones. Reducing the weight and rigidity of a sail's battens facilitates storing them.

As a sail with either external batten reduction technology or integral batten substitute technology tacks or jibes, leech-to-rig contact initiates a repeatable energy cycle. First, respective variable density areas of the sail would yield at each such contact, storing energy. Next, the sail's respective variable density areas would roll sequentially across companion rig element/s, beginning with a lowermost rig contact point and ending at the head the sail, which will be automatically held aback. As the head crosses the intervening rig element, a final release of energy accelerates the boat through the end of the tack or jibe.

A reduced density zone forward of permanent backstay **18** in **Figures 11a and 11b** approximately 2/3 the size of the zone of reduced density aft of the backstay should maximize initial flexing and shock absorption as a sail contacts rig contact points. As the energy cycle continues through a tack or jibe, stored energy bends the batten reduction or substitute, storing energy **much as energy is stored by cocking a bow**; the sail clears the corresponding rig element, releasing stored energy, thus optimizing completion of the tack or jibe. This unexpected power booster adds to the safety of tacking in large waves where boats can fail to complete a tack for want of adequate momentum.

The energy cycle repeats from bottom rig contact point upwards, progressively accelerating a boat through a tack or jibe, as each variable density zone **37a** yields and rebounds, augmenting the acceleration process and establishing a synergism. That synergism resembles one created by the individual coils a 1950's "slinky" spring toy as it surprisingly descended a flight of stairs.

PERFORMANCE AND MARKETING ADVANTAGES OF BATTEN SUBSTITUTE TECHNOLOGY

1. System batten reduction and batten substitute configurations would each enhance a sail's shock absorbing and flexing capabilities while lowering overall sail weight. Each configuration would assure roach support and synergistic energy cycles for optimum tacking and jibing.
2. System design brings to conventionally rigged boats entirely new overlapping sail types, **utilizing permanent backstays advantageously, whereas permanent backstays had always severely limited mainsail shape and size.**

USE OF KNOWN MATERIALS AND METHODS, PATENTED AND UNPATENTED

The System parts list includes the Dutchman™ deployment control system **73.** In addition, diverse patented fiber orienting sail making methods could be used to produce the System's high-density batten reduction sleeves **37a** or entire System sails. Use of a patented component does not obviate an invention's patentability. Furthermore, as concerns Applicant's System, each use of patented methods or materials is a **new use** that neither the prior art nor the respective inventors had foreseen or intended.

The following examples illustrate **unforeseeable** as opposed to foreseeable uses of patented products or technology:

1. **Unforeseeable:** use of patented fiber-orientating sail making technology to make external high-density batten reduction sleeves **37**, integral batten substitutes **37b** and variable density zones **37a** and **37c for use on conventional, panel-cut sails.**

2. **Unforeseeable:** use of patented Dutchman deployment System **73** in combination with a self-boomed sail to enable single line reefing. Dutchman systems were conceived uniquely for use with a rigid external boom setting a sail having battens parallel to the boom. U.S. Patent No. 4,688,506 to **Van Breems** (1987) clearly limited its invention to sails having battens lying **parallel to external booms:**

   " [A Dutchman system consists of] ...one, two, or three control lines which run parallel to the mast **from the boom** to a **topping lift**....Equidistant...battens run parallel to the boom....The sail control system...**will** employ the existing boom...." (Van Breems, p. 1, lines 30-65).

Confirming the foregoing, each of the Van Breems drawings shows a "boom" identified with the number "16" in the case of both mainsails and jibs. Thus limited, the coverage of Van Breems could in no way, explicit or implicit, extend to System sails that have diagonal battens disposed pursuant to predetermined maximum roach parameters, and that eliminate booms altogether. System sails are, therefore, distinct from Van Breems and referenced prior art, which nowhere described, depicted or suggested a headsail or mainsail having the foregoing properties, either separately or in combination.

Applicant's use of the Dutchman deployment system in an unforeseeable context produced unexpected new results that had been ignored entirely or even deemed impossible by the Van Breems patent. For example, self boomed Maxmain **30** attaches a Dutchman deployment system **73** at an angle to and well above the Maxmain's foot, whereas Van Breems specifies attachment at foot level and in the axis of a sail's foot.

Where Van Breems required an external boom, the System eliminates them. Van Breems required boom -parallel horizontal battens, whereas the System employs diagonal battens. The System employs Dutchman deployment systems **73** in diverse new contexts, each providing not only deployment control but also uniform foot support and horizontal foot extension in both fully deployed and reefed configurations, all in the absence of a boom. Finally, System sails can produce their entire range of functions and results without resort to a Dutchman system. In summary, the System's new and unexpected results mark a qualitative advance in the art of sail power, notably as concerns sails

that eliminate external booms. Van Breems discloses only a narrow advance in deployment control methods for a sail set from an external boom.

Preferred System embodiments can use the Dutchman system, but lazy jacks or no deployment control device at all are other alternatives. Those alternatives facilitate addressing a broader market. A Dutchman deployment system **73** is simply one possible item of the parts list for System embodiments.

Similarly, use of a patented fiber orientation construction method to build a System sail or to build high-density batten reduction sleeves **37a** represents no more than a purchase of existing methods and materials from an authorized vendor pursuant to that vendor's price list. Such use of fiber orientation sail making technology is a new and unforeseen use for the production of new and unexpected results.

3. **Unforeseeable:** Diagonal batten configurations as well as Batten substitute configurations including diagonal ones. Van Breems is exemplary in teaching only conventional, horizontally oriented batten configurations.

"6. A sail control system as recited in Claim 2and further comprising a plurality of vertically spaced battens **fixed to the sail** and **extending horizontally** across the sail...." (Van Breems, p. 4, lines 25-29.)

4. **Foreseeable:** Use of a patented mainsheet boom pulley System as a mainsheet vang pulley system. In such case, the pulley system would be performing its intended force-multiplication-function between different, but nonetheless foreseeable attachment points necessarily and customarily controlled by such a block-and-tackle device.

SUMMARY OF UNEXPECTED NEW RESULTS AND SYSTEM INNOVATIONS

The System's unexpected new results and innovations include the following:

1. Unique predetermined maximum roach parameters enable Optimized, overlapping self-tacking, self-boomed headsails and mainsails compatible with the rig of any sailboat.
2. Overlapping, self-tacking **System sails use permanent backstays to advantage,** whereas permanent backstays had always posed a negative restriction on sail size and shape. System sail leech-to-rig contact automatically accelerates System sails through tacking and jibing maneuvers Heretofore, such a result has been considered impossible.
3. Self-tacking Optimized System sails optimize the sail area and efficiency of any sailboat without modification to boat or rig; unexpectedly constituting an unexpected, cost-effective alternative to tall rig options and retrofit modifications.
4. System sails eliminate external booms which have heretofore been indispensable to single-line reefing. Diagonal semi-rigid batten layouts automatically and progressively resist inward reef line forces as a System sail is reefed, eliminating external booms,
5. System Sails combine comprehensive, 100% cockpit-controlled deployment, reefing, and recovery with true working sail versatility for optimum performance and convenience in wind speeds from five to thirty-five knots and above.
6. Unexpectedly, both boat builders and buyers can realize savings by realizing optimum performance while avoiding costly rig and boat modifications..
7. Optimum interface between Optimized sails replaces the turbulent interface between inefficient triangular headsails and mainsails.
8. Full dynamic sail response to changing wind and sea conditions resulting from elimination of rigid external spars.
9. Headboard-end end plate combination **74 unexpectedly** combines safety results with aerodynamic results **usually related to the foot of a sail** to produce intersail synergism while optimizing safety and performance.
10. **Unforeseen** use of a Dutchman™ vertical deployment control lines to evenly support the foot of a **boomless** System sail enabled cockpit controlled single-line headsail and mainsail reefing in the absence of an external boom.
11. Compatible with both "lazy bags" as well as lazy jacks, System sails assure maximum marketability.

12. New semi-rigid batten layouts produce self-booming, self-vanging, and reinforced reef triangulation functions.

13. Unprecedented applications of fiber-oriented laminated sail making methods enable smaller, lighter battens or eliminate battens altogether.

UNEXPECTED RESULTS PRODUCED BY SOLVING INSOLVABLE PROBLEMS

In finding the following solutions to insolvable problems, Applicant's System produced major new and unexpected advances in the art of sail power:

1. 30% more sail area without resort to long-footed genoas, free flying sails, or costly tall rig transformations.

2. Universally compatible predetermined maximum roach parameters

3. New batten; batten reduction; or batten substitute configurations that enable self-boomed, self-tacking overlapping semi-elliptical headsails and mainsails.

4. **Converting** a permanent backstay from **an absolute disadvantage to an operational advantage** when tacking and jibing.

5. Hoisted, overlapping, self-tacking sails that rival or better the performance, convenience and safety of furling counterparts.

HOISTED SYSTEM CONFIGURATIONS BETTER CONVENTIONAL FURLING CONFIGURATIONS

Relatively inefficient furling configurations achieved market dominance because they were convenient and safe to use. **The System's hoisted working sails provide equal or better convenience and safety plus lower cost, true versatility, and Optimized performance.**

The System's hoisted sails impose no compromise. Indeed, no imaginable configuration, hoisted or furling, approaches the functional and economic advantages of System working sails for conventionally rigged sailboats. For example, the System eliminates external spars, not with a loss of capability, but rather, with gains in convenience and safety that only increase as conditions deteriorate.

MARKET PRECEDENTS: UNEXPECTED PRODUCTS AND COMMERCIAL SUCCESS

1. "Big Bertha" golf clubs "invented" their own market just when golf club design seemed to have reached an impasse.
2. A surfer and a sailor combined their ideas; decided a human body could replace a mast; and created sailboards. Sailboards still sail faster than even the most radical sailboats. In a similarly unprecedented synergism, the System combines the bottom of a self-tacking sail and the top of an overlapping sail to create unprecedented overlapping self-tacking headsails and mainsails.
3. The mainstream sail market has long demanded easily controlled, truly versatile self-tacking sails that are cost-efficient and cy and aesthetic. Applicant's System delivers reduces those demands to practice using existing sail making materials and methods.

MARKETING CLAIMS AND DOWNWIND SAILING REALITIES

A truly convenient free flying sail a contradiction in terms. All free-flying sails require poles for effective downwind sailing.

"Pole-less cruising spinnakers are great on a reach, but they can collapse or oscillate too much as the boat bounces around in ocean swells... a traditional [poled] symmetrical spinnaker is more versatile than an asymmetrical cruising spinnaker since you can use it on more numerous points of sail."(UK sailmakers Newsletter, Dec. 2001).

A truly safe and convenient system for fast downwind sailing that eliminated on-deck sail handling would be both a market success and a revolution in sail power. Self-boomed, self-tacking Maxjibs and Maxmains provide just such a result; assuring balanced surface area for cockpit-controlled, high performance-low effort downwind sailing regardless of crew size or conditions. The System makes having "the right sail at the right time" a routine matter for shorthanded crews.

ADVANTAGES AND OBJECTIVES OF THE SYSTEM – SUMMARY

1. Optimized mainsails and self-tacking headsails providing optimum performance, convenience and safety in all conditions regardless of crew size or skill.

2. Optimum performance, convenience and safety for any conventionally rigged sailboat without modification to boat or rig.

3. A sail System that at once reduced costs for boat buyers and improved profits for the sailboat industry.

4. A System sail design that produced synergism and cost-effective wind power for both recreational and commercial users of wind-powered craft.

ADDITIONAL CONTENT

In addition to the foregoing Specification, the present Amendment also includes:

1. A list of reference numerals.

2. A description of drawings.

3. A review of the System's theoretical basis.

4. Instructions for making and using the System.

5. A description of main and alternative embodiments of the invention and its additional ramifications.

6. Three main claims plus twelve dependent claims; and

6. An Abstract.

LIST OF REFERENCE NUMERALS

mast 10

mast track 11

forestay 12

inner forestay 14

halyard 15

forward lower shroud 16

permanent backstay 18

wishbone 19

boom 20

pulley 21

clew ring 22

tack ring 23

head ring 24

padeye 25

overlapping Maxjib 26

non-overlapping Maxjib 28

self-boomed Maxmain 30

external-spar Maxmain 32

diagonal closed batten pocket 34

diagonal open batten pocket 35

horizontal closed batten pocket 36

high-density external batten reduction sleeve 37

external variable density batten sleeve zone 37a

integral batten substitute 37b

integral variable density zone 37c

variable density batten zone 37d

round batten 38

flat batten 40

leech batten box 41

ring-end luff batten box 42

sail slide luff batten box 43

flat-end luff batten box 44

fork-end luff batten box 45

sail hank 46

sail slide 48

jackline 50

downhaul 52

reef line 54

topping lift 55

strop 58

luff reef point 60

leech reef point 62

self-tacking sheet 64

port and starboard sheets 66

Lazy jacks 68

Dutchman eyelets 69

Dutchman tab 70

Lazy jack tab 71

Dutchman vertical control line 72

Dutchman deployment control system 73

headboard-end plate combination 74

metal grommet 75

headsail furling mechanism 76

initial Maxjib rig contact point 80

initial Maxmain rig contact point 82

backstay contact diagonal 84

head-to-clew diagonal 85

overlapping Maxjib rig contact diagonal 86

horizontal leech limit construction line 88

vertical extremities construction line 89

leech measurement intersection 90

forward girth segment 92

aft girth segment 94

leech limit point 96

head 98

luff 99

tack 100

foot 101

clew 102

reinforced foot band 103

overlapping Maxjib leech curve 104

non-overlapping Maxjib leech curve 106

Maxmain leech curve 108

ellipse 110

tall rig jib 111

tall rig mainsail 112

tall rig mast 113

counterpart overlapping triangular genoa 114

snap shackle 116

mast track insert 118

mast track gate 120

DESCRIPTION OF DRAWINGS

Figure 1 is a side view of a sailboat with a conventionally boomed Maxmain and a non-overlapping Maxjib with comprehensive integral control functions.

Figure 2 is a side view of a two-masted sailboat with an overlapping Maxjib forward, a non-overlapping Maxjib amidships, and an overlapping, self-boomed Maxmain aft, each sail having comprehensive integral control functions

Figure 3 is a side view of a sailboat with a reefed, self-boomed Maxmain aft and a reefed, overlapping Maxjib connected to an inner forestay forward.

Figure 4 is a partial side view of a fully deployed, self-boomed Maxmain showing its single-line reefing system, its two lowermost battens, and the connection of those battens to a companion mast track by respective leech batten boxes.

Figure 4a is a partial side view of a reefed, self-boomed Maxmain showing a reefing triangulation comprising the sail's two lowermost battens and companion mast.

Figure 5 is a partial side view of a fully deployed, overlapping Maxjib showing its single-line reefing System, its three lowermost battens, and their connection to an inner forestay.

Figure 5a is a partial side of a reefed, overlapping Maxjib showing a reefing triangulation comprising the sail's two lowermost battens and companion inner forestay.

Figure 6 is a side view of a sailboat with a tall-rig mast, tall-rig conventional mainsail and tall-rig working jib superimposed over a standard height mast with tall-rig-area-equivalent Maxjib and Maxmain.

Figure 6a is a side view of a sailboat with a standard height mast and a triangular 130% genoa superimposed with an area-equivalent overlapping, self-tacking Maxjib.

Figure 7 is a side view of an overlapping Maxjib superimposed with an oriented ellipse along with specific leech curve calculation reference points and lines.

Figure 7a is a side view of an overlapping Maxjib set from a sailboat's inner forestay setting forth the relation of the sail's leech curve with companion rig elements.

Figure 8 is a side view of a non-overlapping Maxjib superimposed with an oriented ellipse along with specific leech curve calculation reference points and lines.

Figure 8a is a side view of a non-overlapping Maxjib set from a sailboat's inner forestay and the relation of the sail's leech curve with companion rig elements.

Figure 9 is a side view of a Maxmain and a superimposed oriented ellipse along with specific leech curve calculation reference points and lines.

Figure 9a is a side view of a Maxmain set from a sailboat's mast showing the relation of the sail's leech curve with companion rig elements.

Figure 9b is a partial perspective view of the head area of a Maxmain showing details of a headboard-end plate combination.

Figure 10 is a partial side view of a lowered, flaked self-boomed Maxmain.

Figure 10a is a partial perspective view of a lowered self-boomed Maxmain with its lowest batten in a sunshade-water catchment configuration.

Figure 11 is a partial side view of a fully deployed overlapping self-boomed Maxmain.

Figure 11a is a partial exploded side view of a rig contact zone of a System sail having an external batten reduction sleeve with an external variable density batten sleeve zone and a semi-rigid batten with a variable density batten zone.

Figure 11b is a partial exploded side view of a rig contact zone of a batten-free System sail having an integral batten substitute with an integral variable density zone.

DESCRIPTION OF INVENTION

System headsail embodiments include **overlapping Maxjib 26** and **non-overlapping Maxjib 28**. System mainsail embodiments include **self-boomed Maxmain 30 and external-spar Maxmain 32.** System sail embodiments may be used in various combinations, and each conforms to a predetermined, embodiment-specific set of maximum roach parameters.

MAKING AND USING APPLICANT'S SAIL SYSTEM

A person skilled in the art pertinent to the present Amendment will be referred to as "a skilled sailmaker". **The Amendment's text and drawings will explain each System sail's construction, installation and use in a manner sufficient to enable An ordinarily skilled sailmaker to make and use Applicant's sail system.** The Amendment's drawings show various System sail embodiments in the scale of Applicant's thirty-three foot "test boat".

TEST PROCEDURES

Applicant performed System prototype test series over an extended period of time and approximately three thousand sea miles. System sails employed materials readily available from suppliers such as Bainbridge International. A description of each System embodiment's materials, construction methods, and cost follows.

MAIN EMBODIMENTS

Applicant's sail system or the "System" comprises the following main embodiments, which are compatible with any conventionally rigged sailboat:

1. Overlapping Maxjib **26**;

2. Non-overlapping Maxjib **28**;

3. Self-boomed Maxmain **30**; and

4. External-spar Maxmain **32**.

HOW TO MAKE THE CLAIMED SYSTEM

EMBODIMENT- COMMON SAILMAKING MATERIALS AND METHODS

ELEMENTS OF A CONVENTIONALLY RIGGED SAILBOAT

Each System sail embodiment is compatible with **any** conventionally rigged sailboat. A conventionally rigged sailboat comprises:

1. A **mast 10** having a **mast track 11** along the length of its aft surface;

2. Rigging wires connecting mast 10 to the sailboat, such wires comprising:

   A. **forward rigging** including a **forestay 12**; and in the case of a twin-headstay sailboat, an **inner forestay 14** ;

   B. **lateral rigging** including a port and a starboard forward **lower shroud 16**; and

   C. **aft rigging** including a **permanent backstay 18**.

Figures **1,2,3,6,7a ,8a,** and **9a** each depict conventionally rigged sailboats.

EMBODIMENT-COMMON SAIL MAKING MATERIALS AND METHODS

A SYSTEM SAIL'S FLEXIBLE BODY, BATTENS, AND BATTEN ACCESSORIES

1. Each System embodiment's flexible body and its batten pockets may be made of either woven or laminated sail cloth; its batten pockets connecting to the sail's body by sewing or gluing. Alternatively, a System sail may be made using patented fiber-orienting lamination sail making technology such as North Sails' "3D" ™ or UK Sails' "Tape Drive" ™.

2. In a manner known to skilled sailmakers, closed batten pockets are reinforced at their closed leech ends to eliminate separate leech batten boxes. A more detailed description of batten pocket alternatives appears below in connection with System embodiments using "Batten Substitute" technology.

3. The text and drawings of the present cause, **"the text"** and **"the drawings"**, respectively, depict System sails incorporating various combinations of horizontally or diagonally oriented conventional round battens **38** and/or flat battens **40**.

4. Corresponding conventional batten boxes contain the luff ends of each System sail's battens as seen, for example, in Figure **4**. Typically, the two parts of such batten boxes are screwed together with the sail between them.

5. Readily available leech batten boxes **41**, as seen in figure **4,** can contain a batten's leech end in the case of non-overlapping battens. Typically, closed-end batten pockets contain overlapping battens as seen in Figures **4** and **5**. Figure **5,** for example, shows diagonal closed leech batten pockets **34** containing the sail's overlapping upper diagonal battens, whereas a leech batten box **41** contains the sail's non-overlapping bottom batten.

EMBODIMENT-COMMON SAIL MAKING MATERIALS AND METHODS

HEAD AREA, HALYARD, AND DOWNHAUL

1. Each System embodiment has a wide **98** as opposed to the pointed apex of a triangular sail. For example, the head of the test boat's current Maxmain and Maxjib are each over twenty-five centimeters wide. Head area detail including headboard-end plate combination **74a** appears in Figures **9a** and **9b**.

2. A halyard **15** attaches to the head of each System embodiment then leads upward over a conventional mast pulley, or sheave, then down to deck level in a conventional manner, as seen in Figure **9a**.

3. As seen in Figure **9b**, headboard-end plate combination **74** made from a rigid metallic or composite material combines the functions of a two-part sail headboard, having a hole for halyard attachment plus port and starboard wings, or end plates. Typically, the sail is riveted between the two parts of the combination, which extends aft from the sail's luff to its leech.

4. Downhaul **52,** which is tied or shackled to a metal grommet **75** just below the sail's head, leads downward to a deck-mounted pulley **21** in the axis of the sail's luff, and then aft to a boat's cockpit area as seen in Figure **1**.

5. The tack ring **23** of System sails typically connects to a strop **58**, which connects the sail and the boat's deck as seen in Figure **1**.

EMBODIMENT-COMMON SAIL MAKING MATERIALS AND METHODS

FOOT AREA AND CONNECTIONS

1. Self-tacking sheet **64** attaches to a deck padeye **25**, then leads to a pulley 21 attached to Clew **102,** then leads downwards to a deck-mounted pulley **21**, then leads aft to a sailboat's cockpit area as seen in Figure **1**.
2. A Maxjib's luff **99** connects to a forestay **12** or inner forestay **14** as seen in Figure **1**; a Maxmain's luff **99** connects to a mast track **11** as seen in Figure **4**.
3. The foot of each self-boomed System sail embodiment has a sewn-on reinforced foot band **103** along the full length of its foot **101** except for self-boomed Maxmain **32**, whose reinforcement band runs above the sail's foot, as seen in Figure **4**. The band may be made of the same material as the sail, itself, or from a more stretch-resistant fabric such as Kevlar ™. Skilled sailmakers are familiar with materials and methods appropriate to such a reinforced foot band.

EMBODIMENT-COMMON SAIL MAKING MATERIALS AND METHODS

TOPPING LIFT AND DEPLOYMENT CONTROL SYSTEM

1. System sail embodiments typically employ a topping lift **55** connecting its clew to a point near the top of its companion mast as seen in Figure **1**. An external spar Maxmain **32** set from a rigid boom having a rigid external boom vang support strut could dispense with a topping lift.
2. Each System embodiment comprises a deployment control System, either lazy jacks **68**, as seen in the amidships sail in **Figure 2**, or a patented Dutchman deployment control System **73** as seen in the forward and aft sails of that figure. Preferred embodiments use a Dutchman system. Since both deployment control systems are known to skilled sailmakers, it will suffice to note how each is attached directly to the foot of a System sail embodiment, as opposed to their usual attachment to an external boom **20:**

A. In the case of lazy jacks **68**, line pairs may attach directly to locally reinforced areas along the foot of any System sail embodiment, or to similarly spaced lazy jack tabs **71** made of heavy fabric or webbing sewn to the sail.

B. In the case of a Dutchman deployment control System **73**, two or more Dutchman tabs **70** are sewn to either side of a System sail embodiment at specific points along its foot. Two or more Dutchman vertical control lines **72** connect to each such Dutchman tab. Each such control line leads upwards through a series of Dutchman eyelets **69** attached to the sail at specific vertical intervals. After passing through a final eyelet near the sail's leech, each vertical control line attaches to a topping lift **55**.

C. Dutchman or Lazy Jack attachment points for a self-boomed Maxmain are placed along a horizontal line running between the sail's clew and its luff, as seen in **Figures 4 and 4a**.

EMBODIMENT-COMMON SAIL MAKING MATERIALS AND METHODS

SINGLE LINE REEFING CONFIGURATIONS

Each System sail embodiment can have one or more sets of reef points. Typically, a Maxjib would have one set of reef points and a Maxmain would have two. Since a single-line reefing configuration applies inward force between a self-boomed sail's luff and leech reef points, the sail's semi-rigid batten layout must resist that force in order to remain in horizontal extension. Heretofore, it has been assumed that a rigid external spar was the **sole** means of accomplishing such horizontal extension. **Figures 1** - **5** show single-line reefing configurations for self-boomed System sails. Skilled sailmakers are aware of reefing configurations appropriate to specific sailing conditions.

Each such single-line reef level comprises a reefing line **54** that attaches to or near to a sail's clew ring **22** then leads upward through a first pulley **21** attached to a reinforced area of the sail's leech at a desired reef level; then horizontally forward through a second pulley **21** attached to a reinforced area of the sail's luff; then downwards through a deck-mounted pulley **21** to terminate in a sailboat's cockpit, as seen in **Figure 4**.

EMBODIMENT-COMMON SAIL MAKING MATERIALS AND METHODS

MAXIMUM ROACH PARAMETERS

Each System sail embodiment's convex leech curve conforms to embodiment-specific predetermined Optimized roach parameters based on contact points between a sail and companion rig elements. Optimized roach parameters are explained below as to enable a skilled sailmaker to make and use the System.

EMBODIMENT– SPECIFIC SAIL MAKING MATERIALS AND METHODS

OVERLAPPING MAXJIB 26: FOOT AREA AND CONNECTIONS

1. The foot of an overlapping Maxjib **26** terminates at its clew **102**. Examples of fully deployed overlapping Maxjibs **26** are seen in **Figures 2** and **7**. Partial exploded views of overlapping Maxjibs are seen in **Figures 5 and 5a**.

2. The foot **101** of overlapping Maxjib **26** connects at its tack ring **23** to a deck-mounted strop **58,** At its clew ring **22,** the sail attaches to topping lift **55** that leads upward to a point near the masthead of mast **10**. Self-tacking sheet **64,** which has been tied or shackled to a deck-mounted padeye **25**, on one side of the companion sailboat, passes through a pulley **21** shackled to clew ring **22.** The sheet then leads through pulley **21** connected to the boat's deck on the opposite side of the boat, then aft to the sailboat's cockpit. Foot connection details for overlapping Maxjib **26** are seen in **Figures 5** and **5a**.

OVERLAPPING MAXJIB 26 : EMBODIMENT-SPECIFIC LUFF CONNECTIONS

Figures 5 and **5a** show a combination of fork-end luff batten boxes **45** and sail hanks **46** connecting the luff of an overlapping Maxjib 26 to a diagonal inner forestay **14** at a series of connecting points. Each such luff batten box comprises two parts which are assembled on either side of the sail then screwed to each other. Each such sail hank is pressed or sewn to a metal grommet **75** fixed along the length of the sail's luff **99**. Each such sail hank clips onto inner forestay **14**.

OVERLAPPING MAXJIB 26 : EMBODIMENT–SPECIFIC BATTEN AND REEF CONFIGURATIONS

Figure 5 shows a lowermost, or first round batten **38** of overlapping Maxjib **26**, contained at its luff end by a fork-end luff batten box **45** attached to the sail's luff at a right angle and closed around inner forestay **14** by a **batten box fixing pin 47**. The first round batten passes through a diagonal closed batten pocket **34,** which is sewn to the sail in the diagonal axis of the sail's first round batten **38,** and which terminates at or near the sail's clew **102**.

The sail's second batten is also a round batten **38**, which may have a slightly smaller diameter than the bottom round batten. For example, if the appropriate diameter for the bottom round batten **38** is twelve millimeters, as for the test boat, a diameter of eight or ten millimeters would be appropriate for the second round batten **38**.

The sail's second round batten **38** attaches to the sail parallel to and above the bottom round batten 38 by means of a diagonal closed batten pocket **34** and a fork-end luff batten box **45**. Vertical spacing between the bottom and second round battens controls the amount of sail reduced by a first reef level. For example, setting the first reef could reduce total sail area by twenty-percent.

Above the sail's second round batten, at approximately equal vertical intervals, additional, or "upper battens", are contained at their respective luff ends inside corresponding **flat-end luff batten boxes 44** fixed to the sail's luff at a right angle, as seen in **Figure 5a**, and at their respective leech ends by diagonal closed batten pockets **34**. Such upper battens can be round battens **38** or flat battens **40**, the former being shown in **Figure 5a** and the latter in **Figure 3**.

Upper battens can be more flexible than lower battens. For example, a flat batten twenty millimeters wide could typically serve as an upper batten for a Maxjib whose bottom and second battens were round battens with a diameter of twelve and ten millimeters, respectively, as was the case with the test boat. Similar batten rigidity ratios would apply to sails of diverse size.

Typically, single or paired sail hanks would connect the sail to inner forestay **14**, as seen in **Figure 5 and Figure 1**. Interbatten sail hanks typically have equidistant spacing, as seen in **Figure 1.** Skilled sailmakers may specify more than two inter-batten sail hanks according to boat and sail size.

As seen in **Figures 5 and 5a**, leech reef point **62** of overlapping Maxjib 26 comprises a metal grommet **75** pressed into a reinforced area near the sail's leech at a level just above the leech end of diagonal closed batten pocket **34** containing the sail's lowest diagonal round batten **38**. The sail's luff reef point **60** comprises a metal grommet **75** pressed into a reinforced area of the sail near its luff.

Reef line **54** attaches to the sail 's clew ring **22**, then leads upwards to a pulley **21** attached to the sail at leech reef point **62**, then leads horizontally through a pulley **21** attached to the sail at luff reef point **60**, then downwards through a deck-mounted pulley **21** and aft to the boat's cockpit, as seen in **Figures 5 and 5a**.

Where one or more additional reef points is desired, a relatively flexible upper batten is replaced with a less flexible round batten **38** and corresponding batten box and batten pocket for each additional set of reef points. Also required for each additional reef level are additional luff and leech reef points **60 and 62,** an additional reef line **54**, and corresponding sail and deck-mounted pulleys **21**.

The configuration seen In **Figure 1** would be appropriate for most Maxjib applications and the configuration of **Figure 5** for most Maxmain applications. Skilled sailmakers are familiar with appropriate batten and reef specifications according to sail and boat size and intended use.

EMOBODIMENT – SPECIFIC PROFILE: OVERLAPPING MAXJIB 26

Figure 7 shows perimeter lines for overlapping Maxjib **26** running from Maxjib head **98** to tack **100**, to clew **102**. The convex aft segment of the sail's perimeter line is its **overlapping Maxjib leech curve 104**. **Figures 7 and 7a** show in detail the sail's overlapping Maxjib leech curve **104** as well as calculation reference points and lines for drawing it.

The overlapping Maxjib leech curve **104** seen in **Figure 7a**, descends from the head **98** of overlapping Maxjib **26** through five successive leech limit points **96** to terminate at the sail's clew **102,** forming an angle of ninety degrees or more with the foot of overlapping Maxjib **26**. For example, the leech-to-foot angle shown in the overlapping Maxjib **26** of **Figures 7** and **7a** is 102-degrees.

<u>EMBODIMENT – SPECIFIC MAXIMUM ROACH PARAMETERS OVERLAPPING MAXJIB 26:</u>

Overlapping Maxjib leech curve **104** conforms to five leech limit points **96**, which derive as follows:

A. **Figure 7A** depicts the foot **101** and luff **99** of overlapping Maxjib **26** relative to companion mast **10** and forward lower shroud **16**, thus defining a lowermost point of contact between the leech of the sail and companion rig elements, including a companion mast or forward lower shroud,

B. **Figure 7** depicts a diagonal line descending from the sail's head **98** to its initial Maxjib rig contact point **80,** that line being the sail's initial Maxjib rig contact diagonal **86**.

C. A provisional or "construction" **ellipse 110** having a midpoint width approximately equal to the prospective sail's foot length is oriented with its horizontal midpoint line over the sail's foot, as in Figure **7.** The ellipse has been oriented so that its aft perimeter approximately intersects the sail's clew **102**.

D. As in **Figure 7**, a vertical line disposed just forward of the sail's tack **100** runs upwards from the level of initial overlapping Maxjib contact point **80** to the level of the sail's head **98**, tracing the sail's **vertical extremities construction line 89**.

E. Vertical extremities construction line **89** consists of six equal segments delineated by equally spaced departure points. Applicant considers a <u>six-segment</u> vertical extremities construction line to be universally applicable and to assure a smooth leech curve.

Dividing a vertical extremities line into <u>less</u> than six segments would not produce a sufficiently smooth leech curve. Dividing a vertical extremities line into <u>more</u> than six segments would yield a smooth leech curve, but in Applicant's opinion, no significant advantage would be gained by such an

increase in line segments. Contrarily, the calculations would become cumbersome and increase the possibility of sail maker error.

F. A provisional or **horizontal leech limit construction line 88** line runs horizontally aft from each such departure point to the forward surface of the sails' companion mast **10**.

G. The intersection of each horizontal leech point construction line **88** with rig contact diagonal **86** establishes a corresponding **leech measurement intersection 90**.

H. From each leech measurement intersection **90**, measure horizontally forward to the sail's luff **99**. Each such measurement defines the length of a **forward girth segment 92**.

I. From uppermost to lowermost, the following percentage of the length of each forward girth segment **92** equals the length of each corresponding **aft girth segment 94**: a. 90%, b. 72%; c. 43%, d. 24%, e. 6%, f. 0%.

J. Combining corresponding forward and aft girth segments, measure the resulting distance aft from the sail's luff along each horizontal leech limit construction line **88**.

K. Each such measurement delimits a corresponding **leech limit point 96**. Thus, if uppermost forward girth segment **92** were twenty-centimeters long, a 90% aft girth segment **94** would be eighteen-centimeters long.

L. Combining the uppermost forward and aft girth segments would yield an uppermost leech limit point **96** thirty-eight centimeters aft of the sail's luff along the axis of the prospective sail's uppermost horizontal leech limit construction line **88**. The prospective sail's other leech limit points **96** are similarly derived.

M. **Overlapping Maxjib leech curve 104** begins at the prospective sail's head **98**, descends successively through respective leech limit points **96** to its clew **102**, to form an angle with the prospective sail's foot **101** equal to or in excess of ninety-degrees. For example, the sail shown in **Figures 7** and **7a** has a leech-to-foot angle of approximately 102-degrees and a wide head area that clears the forward surface of the sail's companion mast **10** by at least five centimeters.

N. To achieve an optimum leech curve, overlapping Maxjib leech curve **104** conforms approximately to oriented **ellipse 110** while respecting leech limit points **96**. Once the sail's two-dimensional profile is finalized, batten spacing appropriate to specific use and sail budget are specified. Leech limit points are not not necessarily batten placement points.

O. Fine synchronization of construction ellipse **110** and overlapping Maxjib leech curve **104** allows transition from the perimeter calculation stage shown in **Figure 7** to the final design configuration seen in **Figure 7a**.

EMBODIMENT–COMMON SAIL MAKING MATERIALS AND METHODS

NON-OVERLAPPING MAXJIB 28

1. The connection of **a non-overlapping Maxjib 28** to a companion vessel is identical to that of an overlapping counter part, as depicted in **Figures 5 and 5a** . The two Maxjib types are best compared by reference to **Figure 2,** which depicts the two Maxjib types on the same vessel.

2. In the following respects, non-overlapping Maxjib **28** is also identical to overlapping Maxjib **26**:

a. sailcloth and batten specification as well as construction methods;

b. Leech and luff batten box specifications;

c. Sail hank specification and spacing;

d. reef line configurations;

e. downhaul configurations; and

f. topping lift configurations.

EMBODIMENT–SPECIFIC SAIL MAKING MATERIALS AND METHODS

PERIMETERS: NON-OVERLAPPING MAXJIB 28

Figures 1 and 2 each show the perimeter lines of a non-overlapping Maxjib **28.** The sail's perimeter line runs from its head **98** to its tack **100**, to its clew **102**. The convex aft segment of the sail's perimeter line is its **non-overlapping Maxjib leech curve 106**.

Figures 8 and 8a show in detail the sail's non-overlapping Maxjib leech curve **106** as well as calculation reference points for drawing it. As seen in **Figure 8a**, non-overlapping Maxjib leech curve **106** descends from the sail's head **98** through five successive leech limit points **96** to terminate at the sail's clew **102**, forming an angle of approximately ninety degrees with the foot of non-overlapping Maxjib **28**. For example, the leech-to-foot angle shown in the non-overlapping Maxjib 28 of **Figures 8 and 8a** is 91 -degrees.

EMBODIMENT- SPECIFIC OPTIMIZED MAXIMUM ROACH PARAMETERS:

NON-OVERLAPPING MAXJIB 26

Non-overlapping Maxjib leech curve **106** conforms to five leech limit points **96**, each of which is derived as follows:

1. **Figure 8a** depicts the foot **101** and luff **99** of a prospective non-overlapping Maxjib **28** relative to companion mast **10** and port and starboard forward lower shrouds **16**, The sail's clew **102** passes approximately five centimeters forward of companion mast **10** and port and starboard forward lower shrouds **16**.

2. As seen in **Figure 8**, a descending diagonal line from the sail's head **98** to its clew **102** is the sail's head-to-clew diagonal **85**.

   P. A provisional or "construction" ellipse **110** having a midpoint width approximately equal to the prospective sail's foot length is oriented, as in **Figure 8**, so that its vertical midpoint line lies parallel to the sail's foot, and its aft extremity approximately intersects the sail's clew **102**. The horizontal midpoint line of the ellipse lies over the sail's foot.

3. Along an axis approximately above the companion sailboat's bow, a vertical line runs upwards from the level of the prospective sail's tack **100** to the level of its head **98**, tracing the sail's **vertical extremities construction line 89**.

4. Vertical extremities construction line **89** consists of six equal segments, thus deriving five equally spaced departure points between the top and bottom of vertical extremities construction line **89**.

5. A provisional or "construction" line runs horizontally from each such departure point aft to the forward surface of the prospective sails' companion mast **10**. Each such horizontal construction line is a **horizontal leech limit construction line 88**.

6. The intersection of each of the five horizontal leech limit construction lines **88** with the sail's head-to-clew diagonal **85** establishes five **leech measurement intersections 90**.

7. From each leech measurement intersection **90**, measure horizontally forward to the sail's luff **99.** Each such measurement defines the length of a **forward girth segment 92**.

8. From uppermost to lowermost, the following percentage of the length of each forward girth segment **92** equals the length of a corresponding **aft girth segment 94**: 80%, b. 30%; c. 20%, d. 6%, and e. 1 %.

9. Combining corresponding forward and aft girth segments results in a horizontal distance aft from the sail's luff along each of the sail's five horizontal leech limit construction lines **88**.

10. Each such combination of forward and aft girth segments terminates at one of the sail's five **leech limit points 96**. Thus, if uppermost forward girth segment **92** were twenty-centimeters long, an 80% aft girth segment **94** would be sixteen-centimeters long.

11. Combining the uppermost forward and aft girth segments would yield an uppermost leech limit point **96** thirty-six centimeters aft of the sail's luff along the axis of the prospective sail's uppermost horizontal leech limit construction line **88**. Each of the prospective sail's five leech limit points **96** is similarly derived.

12. As seen in **Figure 8a**, **non-overlapping Maxjib leech curve 106** begins at the head **98** of the prospective sail, descends successively through its five leech limit points **96** to its clew **102**, forming an angle of approximately ninety-degrees with the prospective sail's foot **101**. For example, **Figures 8 and 8a**, each show a non-overlapping Maxjib **28** having a leech-to-foot angle of approximately 91-degrees and a wide head area that clears the forward surface of the sail's companion mast **10** by at least five centimeters.

13. The resulting non-overlapping Maxjib leech curve **106** conforms as closely as possible to oriented ellipse **110** while respecting all leech limit points **96**.

14. Fine synchronization of construction ellipse **110** and non-overlapping Maxjib leech curve **106** completes the transition from the perimeter calculation stage shown in **Figure 8** to the final design configuration seen in **Figure 8a**.

EMBODIMENT– SPECIFIC SAIL MAKING MATERIALS AND METHODS

SELF-BOOMED MAXMAIN 30: BATTENS, BATTEN BOXES, AND REEF SYSTEM

1. As seen in **Figure 3, self-boomed Maxmain 30** employs a first diagonal round batten **38**, which runs downwards from its clew to its tack.

2. Batten, batten pocket, and mast connection details are seen in **Figures 4 and 4a**. As seen in those figures, the aft end of the sail's first diagonal round batten **38** passes through a diagonal batten pocket **35** sewn to the sail and terminates and terminates in a conventional screwed-on **leech batten box 41**attaching to the sail at or near its clew.

3. A sail slide luff batten box **43** attached to the sail's luff contains the forward end of the sail's first round diagonal batten **38**, which forms a batten-to-luff angle of approximately 72-degrees.

4. At its tack, the sail connects to mast track **11** by a combination of a sail slide **48** sewn to a metal grommet **75**. Typically, such a grommet-slide combination connects the sail to mast track **11** along the sail's luff and at its head and tack. Vertical slide spacing, known to ordinarily skilled sailmakers, is according to sail size and intended use.

5. Self-boomed Maxmain **30** has **two** reinforced foot bands **103**; a first, diagonal one along the length of its diagonal foot **101** and an a second, horizontal one running from the sail's leech to its luff just above the sail's lowest set of reef points **60** and **62**.

6. Dutchman tabs **70** are sewn to the sail at the level of a self-boomed Maxmain's horizontal reinforced foot band **103**, as seen in Figures **4, 4a, 10,** and **10a**.

7. At the point where horizontal line beginning approximately 10 mm. below the fully-hoisted Maxmain's clew **102** intersects with mast track **11**, a mast track insert **118** screws into mast track **11**.

8. Above mast track insert **118**, a second, horizontally oriented round batten configuration is attached to the sail; connecting at its leech end by a horizontal closed batten pocket **36** and at its luff end by a sail slide luff batten box **43** as seen in Figure **4**.

9. At intervals above the sail's second, horizontal batten, additional horizontal, "upper battens" attach to the sail as seen in Figure **2.** The sail's upper, horizontal battens may be round or flat, and are typically more flexible than the sail's two lower, diagonal battens. Each upper batten is contained at its leech end by a horizontal closed batten pocket **36**, and at its luff end by a sail slide luff batten box **43**.

10. Leech reef point **62** of self-boomed Maxmain 30 comprises a metal grommet 75 pressed into a reinforced area near the sail's leech at a level just below the horizontal closed batten pocket **36** corresponding to sail's second lowermost batten. The sail's luff reef point **60** comprises an identical metal grommet pressed into a reinforced area near the sail's luff at a point horizontally opposite the leech reef point.

11. Reef line **54** attaches to the sail's clew ring **22**, then leads upwards through a pulley **21** attached to the sail at leech reef point **62**, then horizontally through a pulley **21** attached at the sail's luff reef point **60**, then downwards through a deck-mounted pulley **21** and aft to the boat's cockpit.

12. For each additional reef level, replace an upper batten with a round batten **38** with rigidity approximately equal to the diagonal batten immediately below it. Each such additional reef level also requires a corresponding batten box; batten pocket: luff and leech reef points; corresponding pulleys and an additional reef line.

13. One reef point would be typical for coastal sailing and two reef points for offshore use. Skilled sailmakers are familiar with specifying the placement and number of reef points according to diverse factors including the sail's intended use and size; boat size; and local weather conditions.

14. **Figure 4** show details of a self-boomed Maxmain **30** with one reef level in a fully deployed configuration while **Figure 4a** shows the sail in a reefed configuration. The sail's self-tacking sheet attaches to a deck-mounted padeye **25** from which point it runs through a pulley **21** attached to clew ring **22**, then through a deck-mounted pulley **21** on the opposite side of the sailboat's deck, then aft to the boat's cockpit.

15. The self-tacking sheet layout shown in Figures **4** and **4a** gives sufficient mechanical advantage for boats up to about eight meters long, but a four or six-part mainsheet pulley System is typical for boats over nine-meters long.

16. The number of battens used for Maxmains can vary according to boat size and other factors known to skilled sailmakers, but the five-batten layout seen in Figure 1 is appropriate for most Maxmains.

EMBODIMENT-SPECIFIC PERIMETERS: SELF-BOOMED MAXMAIN 30

1. The aft sail of Figure **2** shows the perimeter line of **self-boomed Maxmain 30,** which traces a convex line from the sail's head downwards to its clew, then forward along its convex foot, and finally upwards along the sail's luff to join the sail's head. The convex aft segment of the sail is **Maxmain leech curve 108.**

2. Figures **9** and **9a** show details of overlapping Maxmain leech curve **108** as well as underlying calculation reference points and lines that would enable a skilled sailmaker to make and use the sail. Calculation of a leech curve for a self-boomed or external-spar Maxmain are identical.

3. As seen in Figure **9a**, Maxmain leech curve 108 descends from the sail's head 98 through five successive leech limit points **96** to terminate at the sail's clew **102**, forming an angle of approximately ninety-degrees to the horizontal at the level of the sail's clew. That angle, for example, is 85-degrees for the sail shown in Figures **9** and **9a**.

SELF-BOOMED MAXMAIN 30: OPTIMIZED ROACH PARAMETERS

Maxmain leech curve **108** conforms to five leech limit points **96**, which are derived as follows:

1. Figure **9a** depicts the Maxmain leech curve **108** and luff **99** of a prospective self-boomed Maxmain **30** relative to a companion mast **10** and permanent backstay **18**, thus defining the prospective sail's foot **99** measurements and the lowest point at which the sail could contact the backstay, that point being the prospective sail's **initial Maxmain rig contact point 82**.

2. As seen in Figure **9a**, a provisional or "construction" line descends from the level of the sailboat's masthead to the point at which permanent backstay **18** connects to the sailboat. The resulting line is the **sail's backstay contact diagonal 84.**

3. A provisional or "construction" ellipse **110** having a midpoint width approximately equal to the prospective sail's foot length is oriented, as in Figure **8**, so that its aft perimeter approximately intersects the sail's clew, and its forward perimeter approximately intersects the sail's tack.

4. A vertical line runs upwards in an axis forward of the sail's tack **100** from the level of initial Maxmain contact point **82** to the level of the sail's head **98**, tracing the sail's **vertical extremities construction line 89.**

5. Vertical extremities construction line **89** consists of six equal segments, thus deriving five equally spaced departure points between the top and bottom of vertical extremities construction line **89**.

6. A provisional or "construction" line runs horizontally aft from each such departure point through and aft of permanent backstay **18**. Each such horizontal construction line is a **horizontal leech limit construction line 88**.

7. The intersection of each of the sail's five horizontal leech point construction lines **88** with its rig contact diagonal **86** establishes five **leech measurement intersections 90**.

8. From each leech measurement intersection **90**, measure horizontally forward to the sail's luff **99.** Each such measurement defines the length of a **forward girth segment 92**.

9. From uppermost to lowermost, the following percentages of the length of each forward girth segment **92** equal the length of corresponding **aft girth segments 94**: a. 90%, b. 72%; c. 43%, d. 24%, e. 6%.

10. Combining corresponding forward and aft girth segments results in a horizontal distance aft from the sail's luff along each of the sail's five horizontal leech limit construction lines **88.**

11. Each such combination of forward and aft girth segments terminates at one of the sail's five **leech limit points 96**. Thus, if uppermost forward girth segment **92** were twenty-centimeters long, a 90% aft girth segment **94** would be eighteen-centimeters long.

12. Combining the uppermost forward and aft girth segments would yield an uppermost leech limit point **96** located thirty-eight centimeters aft of the sail's luff along the axis of the prospective sail's uppermost horizontal leech limit construction line **88**. Each of the prospective sail's five leech limit points **96** is similarly derived.

13. Overlapping Maxmain leech curve **108** begins at the prospective sail's head **98**, descends successively through its five leech limit points **96** to its clew **102**, forming an angle with the prospective sail's foot **101** of approximately ninety-degrees. For example, the sail shown in **Figures 9 and 9a** has a leech-to-foot angle of approximately 85-degrees and a wide head area that clears the sail's companion permanent backstay **18** by at least five centimeters.

14. Adjust the resulting leech curve to conform as closely as possible to oriented ellipse **110** while respecting all leech limit points **96**.

15. Fine synchronization of construction ellipse **110** and overlapping Maxmain leech curve **108** completes the transition from the perimeter calculation stage shown in **Figure 9** to the final sail design configuration seen in Figure **9a**.

EMBODIMENT–SPECIFIC SAIL MAKING MATERIALS AND METHODS:

EXTERNAL SPAR MAXMAIN 32

External Spar Maxmain 32 differs from the self-boomed Maxmain seen in **Figures 4 and 4a** in that the external spar sail's foot is horizontal and is attached to an external spar, typically a boom 20, as seen in **Figure** 1. In addition, the sail's upper battens are all horizontal.

EMBODIMENT–COMMON SAIL MAKING MATERIALS AND METHODS:

EXTERNAL SPAR MAXMAIN 32 AND SELF-BOOMED MAXMAIN 30

External-spar Maxmain **32** is identical to the self-boomed Maxmain **30** in the following respects:

A. Sailcloth and batten material specification and construction methods:

B. Reef line configuration;

C. Downhaul configuration;

D. Sail-to-mast connections;

E. Topping lift configuration; and

F. Maxmain leech curve.

EMBODIMENT – SPECIFIC PROPERTIES: BATTEN, FOOT AND LUFF CONNECTIONS

EXTERNAL –SPAR MAXMAIN 32

External-spar Maxmain **32,** shown in **Figure 1,** differs from self-boomed Maxmain **30** in its batten orientation and foot connections:

1. External-spar Maxmain **32** uses **only** horizontal battens. Typically, the sail's battens and corresponding batten boxes would all be of the same type, for example, twenty millimeter wide flat battens **40** with batten boxes appropriate to flat battens, as seen in **Figure 1**.
2. **Figure 1** shows the tack **100** of external-spar Maxmain **32** connecting to the forward and aft ends of its companion boom **20**.

HISTORY OF THE SYSTEM

Cruising sailboats with freestanding masts had appeared by 1980, notably the Freedom cat ketch series. Despite their advantages, boats with freestanding masts would capture less than 5% of the market. Conventionally rigged sailboats would continue to dominate the mainstream sailboat market, and increased convenience would increasingly dominate market priorities.

By 1985 furling working sails had taken the market from hoisted counterparts, proving the market viability of easily handled sails, even if furling configurations compromised performance and cost more than counterpart hoisted configurations. Sailors and designers could not imagine hoisted sails with the convenience of furling sails. Nonetheless, Applicant set out to develop hoisted sails that surpassed furling counterparts on every point of comparison including cost, performance and convenience.

A majority of 1990 sailors wanted more power, but also wanted to work less while sailing. Designers ignored this, instead looking to costly, inconvenient performance compromises such as free-flying sails, tall rigs and exotic mast and sail materials for increased revenues. Contrarily, Applicant sought low-cost elliptical working sails that would work with any boat's rigging. Unexpectedly, the System delivered synergisms that assured optimum performance and convenience regardless of crew size or conditions using only two sails, a hoisted Maxmain and a self-tacking Maxjib.

SYSTEM DESIGN OBJECTIVE

THEORETICAL BACKGROUND OF THE PRESENT INVENTION

The practical problem for System design was first, getting a maximum amount of the most efficient type of sail area to work with any sailboat's existing rig; and second, controlling that sail area conveniently from the safety of a boat's cockpit. The unprecedented solution lay in universally compatible semi-elliptical self-tacking sails.

Triangular sails were the worst possible aerodynamic solution. "From the perspective of induced drag, the worst shape for an airfoil is a triangle, the shape of a headsail and, to a lesser extent a main (Whidden, The Art and Science of Sails, St. Martin's Press (1990).

APPARENT DESIGN OBSTACLES

Reducing System design objectives to practice presented the following issues:

1. Could elliptical form, which had proven its efficiency for airplane wings be reduced to practice for working sails of conventionally rigged sailboats? The long-standing and obvious answer was, "no".
2. Hoisted self-tacking jibs, which offered maximum safety and economy, were necessarily small, hard-to-handle sails useful only in wind speeds above fifteen knots. Could a small hoisted self-tacking sail somehow evolve into a "big" self-tacking sail? The obvious answer was, "no."
3. Viewed inversely, could a big, hoisted overlapping headsail that required separate port and starboard sheets somehow keep its sail area yet tack and jibe automatically with just a single self-tacking sheet, then somehow get "smaller" again as wind speed increased? The obvious answer was "no".
4. Large-roach mainsails, which overlapped a companion permanent backstay **18**, were deemed unfeasible. Large-roach mainsails were considered feasible only for "unconventionally rigged" boats having no permanent backstay. Such boats constituted less than ten-percent of modem sailboats.

WHY OVERLAPPING SELF-TACKING HOISTED SAILS WERE UNIMAGIINABLE

1. Overlapping hoisted headsails inevitably required <u>separate</u> port and starboard sheets and imposed high tacking effort, whereas self-tacking headsails controlled by <u>only one</u> self-tacking sheet enabled tacking and jibing without crew intervention. "Overlapping" and "self-tacking" sails had obviously incompatible properties.

2. In addition, designers invariably used the term "self-tacking sail" to describe a "non-overlapping jib" and the term "overlapping sail" to describe a "genoa".

3. To restore order, the term **"self-tacking"** describes a sail whose clew **102,** controlled by only a only a single self-tacking sheet **64,** tacks and jibes across a sailboat's deck without contacting rig elements. Used precisely, the term "self-tacking" is a term of <u>function</u> concerning only the clew and sheet configuration of a sail without regard to whether any part of the sail other than its clew or the sail's sheet overlaps the boat's mast or rigging.

   Stated precisely and simply, a self-tacking sail is a sail controlled a single sheet that is capable of repeatedly tacking and jibing without crew intervention. The term has been misused because designers have always assumed that no part of a self-tacking sail could contact rig elements.

4. Used precisely, the term **"Overlapping"** describes the static physical relation between a sail's perimeters and a sailboat's rig elements without regard to whether the sail might be capable of repeatedly tacking and jibing without crew intervention. Designers have always assumed that tacking and jibing an overlapping sail required crew to alternately tension separate port and starboard sheets. Thus have <u>two unperceived, invariable errors in terminology</u> locked designers inescapably to the worst possible profile for working sails, the triangular profile. A transition to the optimum profile for working sails, the elliptical profile was heretofore unthinkable, as was a self-tacking overlapping headsail.

QUESTIONS DESIGNERS NEVER ASKED

Had designers pursued functional inquiry rather than assumptions, they might have asked, "Can a headsail have both light air power and self-tacking convenience?" Stated otherwise, "can an overlapping headsail comprise a self-tacking function?" Glib answers might well have included, "genoas can't self-tack, and pigs can't fly."

UNOBVIOUS QUESTIONS

The following questions were so far beyond what the prior art deemed possible, that the questions, themselves, were ignored.

1. Could more efficient semi-elliptical hoisted headsails and mainsails overlap a boat's rig elements yet retain self-tacking convenience and safety?

2. Could hoisted, self-tacking semi-elliptical headsails and mainsails satisfy wind speeds from five to thirty-five knots yet offer self-tacking safety and convenience for any conventionally rigged sailboat?

3. Could an integral roach support System consisting of semi-rigid battens eliminate the need for costly, heavy external spars as well as external vangs?

EMBODIMENT – COMMON DESIGN PROBLEMS

1. Reducing all-condition Optimized working sails to practice obliged Applicant to develop predetermined maximum roach overlap parameters that reconciled optimum sail shape, maximum surface area, and safe, reliable, all-condition tacking without unusual sail wear. Heretofore, such parameters have been considered unfeasible.

2. To meet convenience and safety objectives, such sails would have to integrate cockpit-controlled downhaul, deployment control, and single-line reefing functions. Single-line reefing had always required that an external spar hold a sail's foot in horizontal extension against inward reef line forces. Design objectives called for self-boomed Optimized self-tacking sails with single-line reefing.

3. Finally, an integral sail framework would have to assure both roach support and optimum sail shape through a wide range of wind and sea conditions.

MAXMAIN - SPECIFIC PROBLEMS

1. Orienting the luff end of a Maxmain's lowest batten upwards might have provided a functional triangulation, but the upwards-oriented batten would have been longer than the sail's foot **101**, making it impossible to safely lower or reef the sail.

2. Nor would safety or convenience allow leaving the lower part of a sail permanently hoisted and lowering the rest of the sail onto the permanently hoisted bottom batten.

3. Similarly, attaching the bottom diagonal batten and tack of the sail to the mast with an adjustable line, or "jackline" could not satisfy safety and convenience requirements. Theoretically, a jackline

might enable lowering the sail. However, handling a sail with a free-floating tack would be unsafe in even slight seas. Even if a jackline were functional in the present context, a separate jackline would be required for each diagonal batten, creating a tangle of control lines that even the most skilled crew could not safely manage.

4. An inclined ramp inside a boat's mast might allow a diagonal batten to be raised and lowered, but would be economically unrealistic for broad market penetration and would interfere with internal mast halyards.

DOWNWARDS – ORIENTED BOTTOM BATTEN: SELF-BOOMED MAXMAIN 30

1. Orienting a self-boomed Maxmain's lower batten downwards between its clew **102** and companion mast **10** would reverse the Maxjib triangulation, bringing into force passive sail control, as opposed to active sail control. Where a Maxjib's lowest batten actively holds its foot in extension and controls upwards clew movement, a self-boomed Maxjib's bottom batten transfers forestay movement to the sail, actively pushing the sail's clew down and aft thus holding its foot in extension (self-booming) and resisting upward clew movement (self-vanging).
2. Unexpectedly, reversing the Maxjib concept yielded self-boomed Maxmain **30** whose bottom batten passively booms and vangs the sail. Unlike a headsail attached to a diagonal, semi-rigid forestay, a Maxmain attaches to a rigid, vertical companion mast **10,** which does **not** transfer the wind's energy to the sail's lowest batten. Rather, a mast acts only as a rigid connection point for the forward end of a Maxmain's bottom batten, thus preventing forward or aft batten movement. So fixed, the Maxmain's bottom batten passively resists both forward and upwards clew movement, thus booming and vanging the sail while enabling the sail to react dynamically to changing wind and sea conditions.
3. The unexpected "reverse triangulation" of Self-boomed Maxmain **30** satisfies reefing requirements while self- booming and vanging the sail. The sail's initial triangulation comprises its downwards-oriented diagonal batten, its bottom horizontal batten, and its companion mast. Lowering the sail's second horizontal batten onto its bottom horizontal batten meets reefing requirements precisely. As seen in **Figure 4a,** lowering a Maxmain for reefing brings its second horizontal batten to rest on the sail's bottom horizontal batten, thus reinforcing the sail's initial, fully deployed triangulation.
4. A self-boomed Maxmain **30**, like a Maxjib responds dynamically to changing wind and wave conditions through the flexing action of its inexpensive, lightweight semi-rigid batten layout. The sail's battens are less prone to breakage than a rigid external spar in the event of contact with a rig

element, and they pose less danger to crew or boat in the case of an accidental jibe or other unforeseen maneuver.

5. Unexpectedly, self-boomed Maxmain **30** eliminates external spars while actually gaining functionality. The sail's downwards-oriented bottom diagonal batten provides a simple, low cost design solution as opposed to multiple jacklines or other complicated configurations that would not work in practice.

6. Adjusting the tension along an external-spar-mainsail's foot usually requires that a crewmember adjust an "outhaul" line that pulls the sail's foot aft. The flexing action of a Maxmain's semi-rigid battens performs this task continually without crew intervention, thus enhancing average speed by an ongoing automatic attention to sail shape.

MAXMAIN – SPECIFIC UNEXPECTED RESULTS

1. Unexpectedly, self-boomed Maxmain **30** eliminated external spars while actually gaining functionality without resort to multiple jacklines or other complicated line arrangements.

2. Shorthanded crews use outhaul lines infrequently because their use is inconvenient and sometimes dangerous. As a result, sail shape is infrequently adjusted to changing conditions. A System sail's semi-rigid battens allow them to "breathe", thus adjusting sail shape continually without crew intervention. Automatic sail shape adjustment both reduces crew fatigue and increases average boat speed.

INSOLVABLE PROBLEM, UNOBVIOUS LOGIC, AND FUNCTIONAL SOLUTIONS

Applicant proceeded from the following logic: While a self-tacking headsail's clew must not contact rig elements, its upper leech may, indeed, contact rig elements provided that the sail can tack and jib reliably and safely in all sailing conditions. Ignoring the prevailing sail design assumption that overlapping sails could not self-tack, Applicant looked for a way to make overlapping headsails self-tack.

The solution lay in combining the foot length of a self-tacking jib with a convex leech curve, yielding a sail design whose integral structure could support a sail's roach area, yet allow it to tack and jibe reliably and safely across rig elements in all sailing conditions Overlapping Maxjib 26, which looks much like a butterfly's wing, provides surface area equivalent to that of a triangular genoa but self-tacks without crew intervention.

Maxmain prototype testing confirmed that battens with overlaps in excess of seventy-centimeters passed easily across the test boat's permanent backstay **18** without hanging up or breaking. Following initial rig contact, a self-boomed Maxmain "rolls" across its companion permanent backstay from initial Maxmain rig contact point **82** upwards.

Maxmain **28** backstay-batten deflection tests should apply equally to tacking and jibing an overlapping Maxjib **26**. An overlapping Maxjib must be able to pass across companion mast **10** and forward lower shrouds **16**. A lower shroud is inclined diagonally inward, away from the sail's tacking arc, thus reducing the shroud's encumbrance to tacking and jibing. A permanent backstay **18** does not have such an inclination. A mast **10** has a larger and smoother exterior surface radius than a rigging wire, thus presenting less resistance to a sail tacking or jibing across it than a backstay.

Optimized roach parameters for overlapping Maxjib **26** and self-boomed **30** or external-spar **32** Maxmains each use a calculation base line that accounts for potential rig element contact during tacking or jibing. This line relates to actual obstructions to tacking and jibing, not arbitrary points on the sail, itself. Thus, System roach parameter calculations relate to permanent backstay **18**, to a line running from the sail's initial Maxjib rig contact point **80** to its head **98**; a companion mast **10** or forward lower shrouds **16**.

Typically, a System sail's clew **102** should clear a companion mast **10** and forward inner shrouds **16** by at least five centimeters. Subject to the foregoing, System sails' convex leech curves conform as closely as possible to an ellipse **110,** as seen in **Figures 7, 8, and 9**.

REDUCTION OF THEORY TO PRACTICE

Prototype testing was performed with a non-overlapping Maxjib **28** and an external-spar Maxmain **32** on the thirty-three foot conventionally rigged "test boat". Prototypes proved entirely reliable in all wind conditions. Boat speed increased by fifteen-percent, and the test boat heeled five degrees, 15% less on average. The non-overlapping Maxjib's low-cost diagonal fiberglass battens provided dynamic self-booming and vanging in changing conditions, and the sail's cockpit-controlled sail-deployment, reefing and downhaul configurations eliminated on-deck sail handling entirely.

Maxmain prototypes having a maximum roach overlap of over 70-centimeters easily crossed the test boat's permanent backstay in winds of five knots or less and at boat speeds as low as three knots. The sails proved just as durable as a non-overlapping mainsail. Subsequent generations of Maxjib and Maxmain prototypes confirmed the feasibility and reliability of predetermined, Optimized maximum roach parameters for the mainsails and headsails of conventionally rigged sailboats.

Having reduced seemingly impossible predetermined maximum roach parameters to practice, Applicant extended the System's design concepts to create unique hoisted self-boomed, self-vanged sail designs for overlapping self-tacking Optimized headsails. Overlapping Maxjib **28** embody those concepts. To extend the benefits of his predetermined maximum roach parameters to boats fitted with rigid booms, Applicant integrated those parameters into the design of external spar Maxmain **30**.

Each prototype System sail proved fully functional using readily available sail making methods and materials. In addition, System designs have been conceived with a view to accommodating and benefiting from evolving batten and sailcloth technology. An example of such accommodation is described subsequently in connection with "batten substitute technology".

ITEMIZED RESULTS OF ONGOING PROTOTYPE TEST PROGRAM

In overview, prototype testing resulted in cockpit controlled, all-condition self-tacking, hoisted Optimized headsails and mainsails that were easily deployed, reefed, and recovered. Ongoing prototype testing repeatedly confirmed the following, often unexpected results:

1. Optimized hoisted System sails emulate taller masts without the associated cost.
2. Optimized hoisted System sails create minimum inter-sail turbulence, thus assuring optimum interface with each other.
3. Reliable predetermined maximum roach parameters are feasible for mainsails and headsails any sailboats, provided that such parameters are related specifically to potential rig contact points.

4. Rig overlap of an Optimized sail not only increases boat speed and reduces heel, but also accelerates a boat through tacks; the contrary of what was expected.

5. In practice, extensive batten deflection tests confirmed easy mainsail passage across a permanent backstay even in light winds. At no time during extended prototype testing did a batten break, or was unusual sail wear perceptible.

6. 6. Prototype Maxmain batten deflection tests and Maxjib batten tests further confirmed the feasibility of self-boomed overlapping Maxmains and Maxjibs, each of which should tack and jibe as easily as the test boat's external-spar Maxmain prototypes.

UNEXPECTED RESULTS IN PRACTICE

1, Among numerous unexpected results, perhaps the least expected was that a System sail's rig overlap actually enhanced boat speed through a tacking maneuver. For example, as a Maxmain tacked or jibed, the sail's head contacted companion permanent backstay **18;** momentarily laid against the backstay, or "aback"; then crossed the backstay in a release of energy that accelerated the boat through the end of the tack or jibe. Heretofore, holding a sail aback required crew to manipulate two sheets and was not possible with a self-tacking sail. Overlapping Maxmains systematically enhance tacking and jibing, and overlapping Maxjibs **26** will undoubtedly replicate that performance.

2. System Maxjibs and Maxmains responded dynamically to changing wind and sea conditions thanks to the flexing of their semi-rigid battens, which also assured self-booming and vanging. Designers had long assumed that booming a sail required a rigid external spar, Contrary to the teachings of the prior art, the flexing properties of a semi-rigid batten enabled self-booming as opposed to undermining it.

3. Similarly, the bottom diagonal round batten **38** of non-overlapping Maxjib **28** prototypes not only held the sail's foot in horizontal extension, but also resisted inward reef line forces. Since the bottom round batten of an overlapping Maxjib **26** mirrors that of a non-overlapping Maxjib **28**, the overlapping Maxjib will no doubt enjoy equal advantages.

4. Unexpectedly, self-boomed Maxmain **30** eliminated external spars while actually gaining functionality. Adjusting the tension along a mainsail's foot enhances sail performance by matching sail depth to wind speed but requires that a crewmember adjust an "outhaul" line that pulls the sail's foot aft. Small crews who want to sail conveniently without constant sail adjustment frequently ignore outhauls altogether.

5. Self-boomed Maxmain **30** at once gains functional and economic advantages by eliminating a rigid spar, which has heretofore been considered indispensable for reefable hoisted mainsails. In addition, a self-boomed sail reduces boat weight and cost.

6. The downwards-oriented bottom batten of Self-boomed Maxmain **30** self-booms the sail and provides a unique, self-reinforcing reef triangulation. The cockpit-controlled sail is fully functional without resort to jacklines or other cumbersome line configurations.

7. The downward, diagonal orientation of a self-boomed Maxmain's bottom batten enables use of the lower part of the sail for water catchment and as a sun awning once the tack of the sail is freed from its mast connections. **Figures 10** and **10a** show the sail in a stowed configuration, and in a sun shade-water catchment configuration, respectively.

The foregoing part of the present amendment, which describes the physical aspects of Applicant's invention, discloses **how to make** it as to allow **one ordinarily skilled in the pertinent art to make the invention.**

MAIN EMBODIMENTS: RATIONALE; INSTALLATION; AND OPERATION

Below, the present Amendment discloses each main System embodiment along with particular **"rationale", "installation",** and **"operation"** details of each, as well as alternative system embodiments and additional System ramifications. The foregoing disclosures, along with those that follow have been drawn as to enable one ordinarily skilled in the pertinent art to **make and use the invention**.

MAIN EMBODIMENTS

1. OVERLAPPING MAXJIB 26
2. NON-OVERLAPPING MAXJIB 28
3. SELF-BOOMED MAXMAIN 30
4. EXTERNAL SPAR MAXMAIN 32

SYSTEM RATIONALE

High performance solutions for fully crewed race boats demand highly skilled crew and important budgets. Only because they have alternately tensioned twin backstays or no backstays at all, can multihull and racing monohull sailboats use big-roach, semi-elliptical mainsails.

Large mainsails, even where feasible, do not compensate for underpowered triangular jibs or genoas. Accordingly, both racing and cruising sailboats still rely on a variety of free-flying sails and long-footed genoas to supplement triangular standing headsails. The high cost of such configurations and the danger to crew associated with such sails is increasingly clear, as seen in spinnaker-related accidents occurring during the recent America's Cup campaign.

To eliminate supplementary sail cost and on-deck sail handling entirely, System design rationale combined maximum sail area, maximum sail efficiency, in two permanently sails that can tack and jibe without crew intervention. Thus ensued a sail System that eliminated dangerous on-deck sail handling maneuvers, minimized crew effort and risk, and made sailing as comfortable as possible for passengers and active crew alike.

OVERLAPPING MAXJIB 26: RATIONALE

A longstanding market demand called for an economical, cockpit-controlled self-tacking headsails with area and efficiency appropriate to a wind speed range of five to thirty five knots. As a first objective, **Overlapping Maxjib 26** was to create a reefable, hoisted headsail that would cost less and carry less weight aloft than area-equivalent furling configurations that require separate port and starboard sheets. Beyond specific cost, power, and self-tacking operation, the sail would need to provide cockpit-controlled deployment, reefing, and recovery. A combination of the foregoing would yield a sail capable or regaining market share hoisted headsails had lost to counterpart furling configurations. As the overlapping Maxjib design evolved, its cost-effectiveness was apparent, both as to triangular furling configurations and, surprisingly, as compared to tall rig configurations. **Figure 3** shows a reefed overlapping Maxjib **26**.

Not only does an overlapping maxjib have 30% more area than a triangular counterpart, but, the most effective part of overlapping Maxjib 26's sail area advantage is high up, at a level where a triangular sail presents no sail area whatever to the wind. **Figure 6a** superimposes a triangular, area-equivalent

genoa over a self-tacking overlapping Maxjib **26.** The triangular, area-equivalent genoa requires crew to alternately tension port and starboard sheets and causes more heel than the Maxjib.

An overlapping rigid external spar is a contradiction in terms, whereas an overlapping self-tacking sail is not so long as the latter sail's clew does not contact a rig element. Eliminating a sail's rigid external spar enables dynamic sail response to changing conditions. In addition, the foot of a flexible sail and its semi-rigid battens impose less risk of injury to crew than a rigid boom during tacking and jibing maneuvers.

Found on most modern boats, overlapping furling genoa configurations are costly and heavy. They are difficult to tack and jibe, and they require crew members to alternately release and tension port and starboard sheets. An overlapping genoa and its separate sheets must cross companion mast and upper and forward shrouds in a loud, violent manner, after which the sheet to be tensioned must be quickly hauled in, placed on a winch, and wound in to the desired point. In some cases a crewmember must go forward and lead a genoa's clew across mast and rigging manually. A failed maneuver poses risk to boat and crew in confined situations.

The violent, crew-intensive passage of a triangular overlapping genoa across companion rig elements contrasts sharply with the orderly, quiet, and automatic passage of an overlapping Maxjib **26** across rig elements. The foot **101** and self-tacking sheet **64** of a Maxjib cross in front of companion rig elements without contacting them.

The sail's momentum induces the lower part of the sail to roll across forward shroud **16** and mast **10** beginning at initial Maxjib rig contact point **80** and proceeding upward until the sail's head **98** crosses to the opposite side of the companion forestay. The sail's battens actually assist the sail in smoothly transiting across mast and rigging, acting as "rails". In sharp contrast, the passage of a flogging conventional overlapping genoa and its sheets across mast and rigging is anything but orderly, smooth. or effortless.

A reefed Maxjib retains its efficient semi-elliptical shape for optimum performance when reefed. Already compromised when fully deployed, an overlapping furling genoa **114** cannot furl to useful self-tacking size. In addition to its performance deficiencies, the separate port and starboard sheets of a

reefed furling genoa demand increasing levels of crew skill and strength as conditions deteriorate. A failed maneuver inevitably causes a boat to lose headway. If the maneuver is abandoned, the boat loses headway, and the genoa can be damaged or make it impossible to assume a safe course. Such a sequence is always fatiguing and is sometimes dangerous. In sharp contrast, **Crew error is not a factor in tacking and jibing a self-tacking sail.** Of equal importance, overlapping Maxjib **26** **automatically accelerates** a boat through the axis of the wind.

Overlapping Maxjib **26** is self-boomed, making it stable while sailing downwind. Similar stability for overlapping genoas or free flying sails requires that crewmembers set a lateral support pole from the mast, Such multi-line maneuvers are crew-intensive and hazardous to boat and crew. In practice, free flying sails and lateral support poles go largely unused shorthanded boats. Unpoled genoas flog loudly and violently in downwind conditions, reducing sail life, comfort aboard and average boat speed.

Sailing downwind with a self-boomed Maxjib avoids the foregoing problems entirely by eliminating poles entirely, thus assuring higher average speeds and optimum safety and comfort for small crews The shorthanded crew's natural tendency to avoid continual lateral pole sets, pole takedowns, and sail changes becomes irrelevant because just two easily managed self-tacking System sails provide the right sail area for any condition, upwind or downwind.

In fact, overlapping Maxjib **26** is a new type of sail, a self-tacking sail that reefs easily and has the surface area of an overlapping genoa. Lower cost and more efficient form make the sail a highly effective and unexpected alternative to costly, inconvenient free-flying light air sails and costly tall-rig options.

OVERLAPPING MAXJIB 26: INSTALLATION

1. A fully hoisted overlapping Maxjib **26** appears in **Figures 1.** A reefed configuration appears in **Figure 3.**
2. With overlapping Maxjib **26** on deck, attach halyard **15** to its head and deck-mounted strop **58** to its tack. Attach downhaul **52** to metal grommet **75** located approximately twenty-centimeters below

the sail's head **98** and lead it through a deck-mounted pulley **21** and eventually aft to the cockpit area.

3. Tie or shackle **self-tacking sheet 64** to a deck-mounted padeye **25** located on one side of the boat's deck then leads through a first pulley **21** shackled to clew ring **22** then through a second pulley **21** fixed to a deck-mounted padeye the opposite side of the boat's deck, then aft to the cockpit, as seen in **Figure 5**.

4. Begin hoisting the sail slowly, bringing successive sail installation components to a convenient working level. As each batten, batten box, sail hank or other installation component appears, proceed as follows.

5. From the sail's head **98** downwards, insert successively the three uppermost battens through corresponding flat-end luff batten boxes **44** until each batten butts against the end of a corresponding diagonal closed batten pocket **34.**

6. As each appears, clip sail hanks **46** onto inner forestay **14** or forestay **12**, as the case may be.

7. Insert each of the two lowermost diagonal round battens **38** through a corresponding fork-end luff batten box **45**, then into a diagonal closed batten pocket **34,** and secure the fork ends around the forestay with batten box fixing pin **47**.

8. Measure the distance between the sail's luff at inner forestay **14** at the level of the sail's two lowest battens. That distance should be approximately twenty millimeters. If it is not, remove batten box fixing pin **47** from batten box fork ends as required, adjust the threaded stud accordingly, and replace the fixing pin, as shown in **Figures 5 and 5a**.

9. Once the sail has been fully hoisted and attached to its forestay, lower the sail, performing each of the following installation procedures as each element reaches a convenient working level.

10. Conforming to **Figure 5**, tie one end of reef line **54** to clew ring **22**, then lead that line upwards to a first pulley **21** attached to the sail at leech reef point **62**; then lead the line through a second pulley **21** attached to the sail at luff reef point **60**, as seen in **Figure 3**; then downwards through a third, deck-mounted pulley **21**; then aft to the boat's cockpit.

11. Install and adjust Dutchman System **73**. As seen in **Figure 2.** Dutchman tabs **70** have been sewn to the sail in accordance with the Dutchman installation manual supplied with each System. After attaching each Dutchman vertical control line **72** to its respective tab, lace each control line upwards through corresponding Dutchman eyelets **69**, exit at the uppermost eyelet, and connect each line to topping lift **55** using the parts provided with Dutchman deployment control System **73.**

When fully installed, the Dutchman control lines will lie parallel to the sail's luff. Skilled sailmakers are familiar with deck layouts for self-tacking sheets as well as Dutchman installation and adjustment.

OVERLAPPING MAXJIB 26: OPERATION

1. Sail Deployment or "hoisting" requires only attaching halyard **15** to the head **98** of overlapping Maxjib **26** and pulling on the halyard. As the sail goes up, it automatically unfolds without flogging by virtue of its Dutchman deployment control System **73**.

2. Self-tacking sheet **64** controls the angle of the sail to the wind.

3. To reduce the sail's area, or "reef" it, release halyard **15** and take in reef line **54**, thus allowing the sail to descend to the desired reef level. Downhaul **52** is available to assist in lowering the sail where, for example, the wind direction is aft of a boat's beam.

4. As an initial reef level is set, the sail's first round batten **38** assumes a horizontal position and is held tightly against the foot of the sail by reef line **54.** Topping lift **55,** along with the Dutchman control lines, maintains equal upward tension along the sail's foot **101**. This constitutes a new, unforeseen use for a Dutchman system.

5. The two lowermost battens of overlapping Maxjib **26** are of the same type and length, and they tack and jibe clear of companion rig elements whether the sail if fully deployed, reefed, or fully lowered.

6. Boats that frequently encounter heavy weather conditions might have one or more additional reef levels. Procedure for setting such reefs is identical to that for the first reef. Applicant used two reefs on a first prototype Maxjib but eventually found one reef sufficient. Skilled sailmakers are familiar with placing reef levels that correspond to the conditions a boat most frequently encounters.

7. **Tacking and jibing a sail controlled by a single self-tacking sheet 64** eliminates the need for crewmembers to alternate of port and starboard sheets. The helmsman simply turns the boat through the axis of the wind and continues on the new course.

8. Unexpectedly, a boat sailing downwind with a self-tacking Maxjib and a mainsail on opposite sides of the boat, or "wing and wing", can maintain a course 20-degrees beyond the point at which a

conventional headsail would jibe. As a result, a boat's mainsail can be trimmed to a more stable, safer angle relative to the wind, that is, approximately 20-degrees inside of the point at which it would normally jibe. This leaves a margin for steering errors which would not be available with conventional counterpart sails in comparable downwind circumstances.

9. Accidentally jibing a boomed mainsail imposes serious risk to boat or crew. Accidentally jibing with a headsail having port and starboard sheets puts the sail aback causing the boat to be uncontrollable until the sheets are alternated.

10. Accidentally jibing a Maxjib has none of the above consequences. The sails' large roach area acts as an air brake as the sail jibes. Attention can thus be focused on the dangerous aspect of downwind sailing, an accidental mainsail jibe, thereby minimizing risk to crew and boat as well as demands on helmsman and autopilot.

11. To **lower** overlapping Maxjib **26,** release halyard **15** and, if necessary, pull on downhaul **52**. The sail descends without flogging or on-deck sail handling. The "Dutchman" combines with the sail's specific batten disposition to eliminate flogging and assure automatic folding or "flaking" as the sail descends. As diagonal battens descends along a companion diagonal forestay, each one assumes a horizontal position as it approaches the foot area of the sail, automatically folding or "flaking" it without crew intervention.

NON-OVERLAPPING MAXJIB 28: RATIONALE

Rationale for non-overlapping Maxjib **28** follows closely that for overlapping Maxjib **26.** The smaller, non-overlapping Maxjib meets the needs of boats with twin headstay configurations or those of boats intended for use in consistently high wind speeds. Like all System sails, non-overlapping Maxjib **26** assures optimum sail efficiency, maximum area and reduced heeling.

NON-OVERLAPPING MAXJIB 28: INSTALLATION AND OPERATION

Installation and operation of non-overlapping Maxjib **28** mirror those of overlapping Maxjib **26**.

SELF-BOOMED MAXMAIN 30: RATIONALE

1. **Self-boomed Maxmain 30** brings comprehensive advantages to hoisted mainsails and assures optimum interface between a boat's standing sails. Maxmain performance, convenience, and cost objectives resemble those for Maxjibs and will not be repeated.

2. If a rigid external spar hits the water in conditions of extreme heel, or hits a boat's rigging during an accidental jibe, the spar can break or dismast the boat. Similar rig contact by a sail with no semi-rigid battens instead of a rigid spar would not produce such catastrophic results. At worst, a batten could break, a relatively insignificant result of what is usually a dangerous accident. Most importantly, contact between a semi-rigid batten and a boat's rigging or the water would not cause a dismasting.

3. As concerns tacking and jibing: during thousands of tacks and jibes the test boat's prototype Maxmains crossed permanent backstay **18** without a single instance of batten breakage or unusual sail wear. At no time was batten-backstay contact remotely hazardous to boat or crew.

4. Mainstream market demand has long called for economical, easily handled sail configurations that do not compromise sailing performance. The foregoing discussion of other System embodiments reveals how the System meets that demand with a wing-like, self-boomed hoisted sail costing less than a counterpart-hoisted mainsail set from an external spar.

SELF-BOOMED MAXMAIN 30: INSTALLATION AND OPERATION

1. In most respects, installation and use of self-boomed Maxmain **30** follows procedures set forth above for the installation and use of Maxjibs **26** and **28.**

2. However, luff connection hardware differs somewhat. Self-boomed Maxmain installation involves inserting sail slides **48** through mast track gate **120** into mast track **11** then finally closing mast track gate **120** once the sail has been fully hoisted with all sail slides inserted into the track.

3. Aside from the above variance, Maxmain and Maxjib installation mirror each other as concerns installing halyard **15**, the sail's battens, Dutchman deployment control System **73**, a self-tacking sheet **64,** and Dutchman or Lazy Jack deployment control lines.

4. **Reefing** self-boomed Maxmain **30** begins with releasing halyard **15**, then taking in reef line **54** until the aft end of the sail's second batten has butted against the aft end of the sail's bottom diagonal batten. If needed, downhaul **52** can be used to assist in lowering the sail. **Figure 4a** shows details of a Maxmain in reefed configuration.

5. Secure reef line **54**, fixing the triangulation between the sail's first horizontal batten, its bottom diagonal batten and the companion mast. Re-tension halyard **15** and secure downhaul **52**.

6. If additional reef levels are present, each is set as above. Once set, each reef level sequentially reinforces the reefing triangle.

7. As it is lowered, self-boomed Maxmain **30** neatly flakes itself. Outhaul **52** is available to assist lowering as desired, for example, with the wind aft of the boat's beam.

8. Once the sail is fully lowered, it can be more compactly stowed by releasing the snap shackle **118** attached to the lower end of strop **58** from its corresponding deck-mounted padeye **25,** then detaching the batten box fixing pin **47** from corresponding sail slide 48. Thus freed from mast track **11**, the luff end of the sail's lowest batten can be raised to a horizontal level and fixed there using strop **58,** thus enabling use of a conventional stowage bag. This configuration is seen in **Figure 10**. Alternatively, the lower triangle of the sail can be used as a sunshade or water catchment ramp, as shown in Figure **10a**.

EXTERNAL SPAR MAXMAIN 32: RATIONALE, INSTALLATION AND USE

Like other System embodiments, External spar Maxmain **32** required universally applicably maximum roach parameters. Those parameters allow a large roach, overlapping mainsail attached to a rigid spar to be used on any conventionally rigged sailboat. The **installation** and **use** of external spar Maxmain **32** replicate those of self-boomed System sail embodiments (see p. 105 immediately above) except that the foot of an external spar Maxmain is horizontal, not diagonal. The sail's horizontal foot connects to a rigid, horizontal boom, and its foot tension is adjusted by an outhaul in the customary manner, a configuration known to skilled sailmakers. A fully deployed external spar Maxmain **32** is seen in **Figure**

The **rationale** underlying external Maxmain **32** differs somewhat from that of self-boomed Maxmain 30. Nearly all existing sailboats set their mainsail from an external rigid boom, and many prospective boat owners will question the wisdom of abandoning the proven rigid boom concept for a self-boomed mainsail. These facts establish an inescapable mainsail marketing climate. The rationale for external spar Maxmains parallels that for marketing the self-boomed batten layout for sails having a conventional profile.

Logically, any sailmaker seeks to obtain maximum sales to a broad-based market segment. The mainsail market is presently composed of boats with rigid external booms. Boat owners are going to be unwilling

to throw away those booms and, indeed, their existing mainsails. For that overwhelming majority of owners, the possibility of using an Optimized System Maxmain with their existing boom will be an extremely attractive idea. For many of those owners **retrofitting** an Optimized Maxmain leech area to their existing mainsail will be an attractive way to access Optimized sail performance and efficiency at a low initial cost.

Applicant foresees that the sale externally boomed Maxmains will constitute an important step in bringing his System and its unique advantages to the attention of the mainstream sailboat market. As this familiarization process evolves, Applicant foresees both boat builders and prospective boat buyers increasingly opting for self-boomed Maxmains since they are beginning without any boom whatever. Since most boats have no jib boom, Applicant believes that market penetration of self-boomed Maxjibs will be more immediate than self-boomed Maxmains, and that proliferation of self-boomed headsails will promote public acceptance of self-boomed Maxmains.

SYSTEM SAILS: ADDITIONAL RAMIFICATIONS

1. Reduced heel is an important factor when conditions or boat use require "motor sailing". In such cases, a self-boomed, hoisted System headsail can be used fully deployed or reefed, reducing wear on a boat's larger, more costly mainsail, which may have an external spar. Taking such an external spar out of action while motor sailing is highly desirable from every point of view.

2. In addition, workboats such as fishing trawlers can benefit from the reduced heel of System sails to gain a more stable working platform. Minimum heel and a low center of effort naturally complement non-ballasted workboat hulls such as trawlers.

3. Optimized roach parameters can apply equally to furling mainsails and headsails.

4. The System is appropriate to other types of wind-powered vehicles such as beach-sailing craft and ice boats.

CONCLUSIONS, RAMIFICATIONS AND SCOPE

Accordingly, the System enables a heretofore-inconceivable reconciliation of optimum performance and optimum convenience for any sailboat. The System unites known and new elements to achieve unexpected new results that include:

1. Unprecedented <u>hoisted</u> sails that eliminate dangerous on-deck sail handling and below-deck sail stowage; converting risk to security, and stowage space to living space.

2. Reliable Optimized roach parameters specific to each System sail embodiment enabling semi-elliptical overlapping mainsails and self-tacking headsailsfor any sailboat.

3. A cost-effective alternative to taller masts yielding benefits to boat buyers and boat builders alike.

4. 30% more sail area with no increase in rig height: a new economics for boat building.

5. Faster, relaxed upwind and downwind sailing. Reduced heel and less fatigue to improve crew performance.

6. Self-boomed, hoisted self-tacking sails with sufficient area for light conditions and cockpit-controlled single-line reefing for heavier conditions.

7. Ideal inter-sail-interface triggers synergism.

8. System design makes optimum use of currently available materials and methods while accommodating evolving technology.

9. New products for long-standing unsatisfied market demands.

10. Hoisted overlapping Maxjibs and Maxmains eliminate costly inconvenient free flying sails and lateral support poles.

<u>NON-RESTRICTIVE SCOPE OF THE INVENTION</u>

Although the above description includes specific examples, these should not be construed as limiting the scope of the invention, but as merely providing illustrations of some of the presently preferred embodiments of it. Consequently, The scope of the invention should be determined by the appended claims and their legal equivalents, rather than by the examples given.

For example, the System can be used on any wind-powered vehicle including iceboats or other land vehicles. The end-plate effect of the headboard combination may incorporate other functions such as electrical connections and solar arrays. Wind power can be cost effective for commercial users such as fishing trawlers or "Club Med- type" passenger vessels, but only if sails for them can fully exploit

available vertical sail space. System sails do so where conventional sails cannot. In summary, the System reduces to practice meaningful sail power for both recreational and commercial users where triangular sails cannot.

CLAIMS

I claim:

21. A sail system comprising a mast, a sheet, a sail having a luff edge, a foot edge, a leech edge, a head, a tack, a clew, and means for attaching the head, tack and clew of said sail to a wind-powered vessel, such sail comprising:

    A. a maximum foot length no greater than 100% "j";

    B. a plurality of sail hanks;

    C. a lower diagonal batten having a first end contained by a luff batten box having forestay connect ability attached at or near the luff of said sail at an angle of approximately ninety-degrees to said luff and a second end contained by a leech batten box attached to said sail at or near the clew of said sail, each such batten box being attached to said sail in the axis of said batten;

    D. a batten pocket attached to said sail in the axis of said batten;

    E. an approximately elliptical positive leech curve descending from the head of said sail through successive leech limit points to the clew of said sail, each such leech limit point deriving as follows :

        i. said sail's head-to-clew diagonal being a line from the head to the clew of said sail;

        ii. said sail's vertical extremities construction line being a vertical line disposed at or forward of said sail's tack and running upwards from the level of said sail's clew to the level of its head;

        iii. said vertical extremities construction line comprising equal segments delimited by horizontal construction lines;

iv. each such horizontal construction line running horizontally aft from said vertical extremities construction line to the companion mast of said sail;

v. said sail's leech measurement intersections lying at respective intersections between each of said sail's horizontal leech limit construction lines and its head-to-clew diagonal;

vi. said sail's respective forward girth segments each being equal to the horizontal distance from successive leech measurement intersections to the luff of said sail;

vii. from uppermost to lowermost, each of said sail's aft girth segments being approximately equal in length to the following percentage of the length of respective corresponding forward girth segments: 80%, 30%; 20%, 6%, and 2%, said percentages corresponding to a preferred six-segment vertical construction line;

viii. each of said sail's leech limit points lying along a corresponding horizontal construction line at a distance aft of the luff of said sail equal to the combined length of corresponding forward and aft girth segments;

F. said sail's leech perimeter beginning at its head and descending sequentially through successive leech limit points to terminate at said sail's clew;

whereby a low cost, hoisted, non-overlapping, self-tacking, self-boomed headsail combines semi-elliptical shape, reconciling optimum performance and optimum convenience.

22. A sail system comprising a mast, a sheet, a sail having a luff edge, a foot edge, a leech edge, a head, a tack, a clew, and means for attaching the head, tack and clew of said sail to a wind-powered vessel, such sail comprising:

A. a maximum foot length no greater than 100% "j";

B. a plurality of sail hanks;

C. a lower diagonal batten having a first end contained by a luff batten box having forestay connect ability attached at or near the luff of said sail at an angle of approximately ninety-degrees to said luff and a second end contained by a leech batten box attached to said sail at or near the clew of said sail, each such batten box being attached to said sail in the axis of said batten;

D. a batten pocket attached to said sail in the axis of said batten, and ;

E. an approximately elliptical positive leech curve descending from said sail's head through successive leech limit points to the clew of said sail, each such leech limit point deriving as follows:

i. said sail's initial Maxjib rig contact point being a lowermost point of contact between the leech of said sail and any companion rig element;

ii. said sail's overlapping Maxjib rig contact diagonal being a line descending diagonally from said sail's head to its initial Maxjib rig contact point;

iii. said sail's vertical extremities construction line being a vertical line disposed at or forward of the sail's tack and running upwards from the level of said sail's initial Maxjib rig contact point to the head of said sail;

iv. said vertical construction line comprising equal segments delimited by horizontal construction lines;

v. each such horizontal construction line running horizontally aft from said vertical extremities construction line to the companion mast of said sail;

vi. said sail's leech measurement intersections lying at respective intersections between each of said sail's horizontal leech limit construction lines and its overlapping Maxjib rig contact diagonal;

vii. said sail's respective forward girth segments each being equal to the horizontal distance from successive leech measurement intersections to the luff of said sail;

viii. from uppermost to lowermost, the length of each of said sail's aft girth segments being approximately equal to the following percentage of the length of corresponding forward girth segments : 90%, b. 72%; c. 43%, d. 24%, e. 6% said percentages corresponding to a preferred six-segment vertical construction line;

ix. each of said sail's leech limit points lying along a horizontal construction line at a distance aft of the sail's luff equal to the combined length of corresponding forward and aft girth segments;

F. said sail's leech perimeter beginning at said sail's head and descending sequentially downwards through successive leech limit points to terminate at the clew of said sail;

whereby a low cost, hoisted, overlapping self-tacking headsail combines semi-elliptical shape and integral booming and vanging to assure optimum performance and convenience in all conditions.

23. A sail system comprising a mast, a sheet, a sail having a luff edge, a foot edge, a leech edge, a head, a tack, a clew, and means for attaching the head, tack and clew of said sail to a wind-powered vessel, each such sail comprising:

    A. a diagonal foot leading from said sail's tack upwards, forming a foot-to-leech angle of approximately ninety degrees, said foot terminating at a clew point forward of a vessel's permanent backstay or, in case of a vessel having no permanent backstay, forward of a line running from the upper extremity of the mast to the center of the aft extremity of said vessel;

    B. a diagonally-oriented semi-rigid bottom batten approximately equal in length to the foot of said sail attached to said sail in the axis of said foot; said batten having a first end contained by a luff batten box having mast connect ability attached at or near the luff of said sail and a second end contained by a leech batten box, each such batten box being attached to said sail in the axis of said diagonal batten;

    C. a horizontal semi-rigid batten running from a point at or near the luff of said sail at approximately the level of the clew of said sail; said horizontal batten having a first end contained by a luff batten box having mast connect ability attached at or near the luff of said sail and a second end contained by a leech batten box attached to said sail at or near the clew of said sail, each such batten box being attached to said sail in the axis of said horizontal batten;

    D. a diagonal batten pocket attached to said sail in the axis of said bottom diagonal batten;

    E. a horizontal batten pocket attached to said sail in the axis of said horizontal batten;

    F. an approximately elliptical leech curve descending from said sail's head through successive leech limit points to its clew, each such leech limit point deriving as follows:

        i. said sail's initial Maxmain rig contact point being a lowermost point of contact between the leech of the sail and a companion permanent backstay ;.

ii. said sail's backstay contact diagonal being a descending diagonal line from the head of said sail to its initial Maxmain rig contact point;

iii. said sail's vertical extremities construction line being a vertical line disposed at or forward of the tack of said sail and running upwards from the level of initial Maxmain contact point to the level the head of said sail;

iv. said vertical extremities construction line comprising equal segments delimited by horizontal leech limit construction lines;

v. each such horizontal leech limit construction line running horizontally aft from said vertical extremities construction line to a point just aft of approximately ten centimeters aft of the clew of said sail;

vi. said sail's respective leech measurement intersections lying successively at the intersection between each of said sail's horizontal leech point construction lines and said sail's backstay contact diagonal;

vii. said sail's respective forward girth segments each being equal to the horizontal distance from successive leech measurement intersections to the luff of said sail;

viii.from uppermost to lowermost , the length of each of said sail's aft girth segments being approximately equal to the following percentage of the length of corresponding forward girth segments: 90%, b. 72%; c. 43%, d. 24%, e. 6% said percentages corresponding to a preferred six-segment vertical construction line;

ix. each of said sail's leech limit points lying along a corresponding horizontal leech limit construction line at a distance aft of said sail's luff equal to the combined length of corresponding forward and aft girth segments;

G. said sail's leech perimeter beginning at its head and descending sequentially downwards through successive leech limit points to terminate at the clew of said sail;

whereby a self-boomed, hoisted, semi-elliptical, mainsail assures greater economy, safety, convenience, and performance than boomed or furling mainsail configurations.

24. The sail system of claim 1, with the following distinguishing or additional features:

a headboard-end plate combination constructed of rigid or semi-rigid light and radar reflective material comprising headboard plates with one or more pairs of integral or mechanically attached port and starboard end plates, each such port or starboard end plate being disposed at an angle of ninety-degrees relative to a corresponding port or starboard headboard plate, the upper extremity of said combination being attached to said sail at a point level with the e upper extremity of said sail;

whereby a new, unexpected combination produces a synergism that enhances non-overlapping headsail performance and safety while optimizing inter-sail interface.

25. The sail system of claim 2, with the following distinguishing or additional features:

a headboard-end plate combination constructed of rigid or semi-rigid light and radar reflective material comprising headboard plates with one or more pairs of integral or mechanically attached port and starboard end plates, each such port or starboard end plate being disposed at an angle of ninety-degrees relative to a corresponding port or starboard headboard plate, the upper extremity of said combination being attached to said sail at a point approximately level with the upper extremity of said sail;

whereby a new, unexpected combination produces a synergism that enhances overlapping headsail performance and safety while optimizing inter-sail interface.

26. The sail system of claim 3, with the following distinguishing or additional features:

a headboard-end plate combination constructed of rigid or semi-rigid light and radar reflective material comprising headboard plates with one or more pairs of integral or mechanically attached port and starboard end plates, each such port or starboard end plate being disposed at an angle of ninety-degrees relative to a corresponding port or starboard headboard plate, said combination being attached to said sail at a point approximately level with the upper extremity of said sail;

whereby a new, unexpected combination produces a synergism that enhances mainsail performance and safety while optimizing inter-sail interface.

27. The sail System of claim 3 with the following distinguishing or additional properties:

A. the sail's foot being connected to an external, mast-mounted rigid spar; and

B. a plurality of exclusively horizontal battens ;

whereby predetermined maximum roach parameters unexpectedly assure universal compatibility of overlapping, boomed mainsails with the rig elements and geometry of conventionally rigged sailboats.

28. The sail system of claim 1 with the following distinguishing or additional properties:

A. one or a plurality of external batten reduction combinations, each such external batten reduction combination comprising a high-density batten sleeve and a companion semi-rigid batten;

B. each such high-density batten sleeve being constructed of sail cloth composed of diagonal or vertical fibers and horizontal fibers, such fibers having a reference density ratio of approximately two diagonal or vertical fibers to one horizontal fiber;

C. each such high-density batten sleeve having one or more variable density zones proximate to rig contact and sail folding points in which zones diagonal or vertical fiber density is reduced by fifteen-percent and horizontal fiber density is reduced by thirty-percent;

D. each such semi-rigid batten having one or more variable density batten zones proximate to rig contact points in which zones batten rigidity is reduced by fifteen-percent;

E. each such external batten reduction combination having a collective rigidity level approximately equal to that of the collective rigidity level of the respective batten and batten pocket it replaces;

whereby lighter external batten reduction configurations enable foldable self-boomed, self-tacking non-overlapping hoisted headsails that reconcile optimum performance and convenience.

29. The sail system of claim 1 with the following distinguishing or additional properties:

A. one or a plurality of integral batten substitutes, each such integral batten substitute comprising a combination of diagonal or vertical fibers and horizontal fibers mechanically or chemically integrated with the body of the sail in the axis of a replaced batten and batten pocket;

B. said fibers having a reference density ratio of approximately two diagonal or vertical fibers to one horizontal fiber;

C. each such integral batten substitute having one or more variable density zones proximate to rig contact points and sail folding points in which zones diagonal or vertical fiber density is reduced by fifteen-percent and horizontal fiber density is reduced by thirty-percent;

D. each such integral batten substitute having a collective rigidity level approximately equal to that of the batten and batten pocket it replaces;

whereby a new use of existing fiber-orientation-sail-making-technology yields batten-free self-tacking, self-boomed, non-overlapping semi-elliptical hoisted headsails with self-supported positive roach.

30. The sail system of claim 2 with the following distinguishing or additional properties:

A. one or a plurality of external batten reduction combinations, each such external batten reduction combination comprising a high-density batten sleeve and a companion semi-rigid batten;

B. each such high-density batten sleeve being constructed of sail cloth composed of diagonal or vertical fibers and horizontal fibers, such fibers having a reference density ratio of approximately two vertical or diagonal fibers to one horizontal fiber;

C. each such high-density batten sleeve having one or more variable density zones proximate to rig contact and sail folding points in which zones vertical or diagonal fiber density is reduced by fifteen-percent, and horizontal fiber density is reduced by thirty-percent;

D. each such semi-rigid batten having one or more variable density batten zones proximate to rig contact points in which zones batten rigidity is reduced by fifteen-percent;

E. each such external batten reduction combination having a collective rigidity level approximately equal to that of the collective rigidity level of the respective batten and batten pocket it replaces;

whereby external batten reduction configurations enable overlapping, self-tacking, self-boomed hoisted headsails that optimize tacking and jibing.

31. The sail system of claim 2 with the following distinguishing or additional properties:

A. one or a plurality of integral batten substitutes, each such integral batten substitute comprising a combination of diagonal or vertical fibers and horizontal l fibers mechanically or chemically integrated with the sail in the axis of a replaced batten and batten pocket;

B. said combination of fibers having a density ratio of approximately two diagonal or vertical fibers to one horizontal fiber;

C. each such integral batten substitute having one or more variable density zones proximate to rig contact points and sail folding points in which zones diagonal or vertical fiber density is reduced by fifteen-percent, and horizontal fiber density is reduced by thirty-percent;

D. each such integral batten substitute having a collective rigidity level approximately equal to that of the batten and batten pocket it replaces;

whereby a new use of existing fiber-orientation sail making technology yields batten-free, overlapping, semi-elliptical hoisted headsails having self-supported positive roach.

32. The sail system of claim 3 with the following distinguishing or additional properties:

A. one or a plurality of external batten reduction combinations, each such external batten reduction combination comprising a high-density batten sleeve and a companion semi-rigid batten;

B. each such high-density batten sleeve being constructed of sail cloth composed of diagonal or vertical fibers and horizontal fibers, such fibers having a reference density ratio of approximately two diagonal or vertical fibers to one horizontal fiber;

C. each such high-density batten sleeve having one or more variable density zones proximate to rig contact and sail folding points in which zones diagonal or vertical fiber density is reduced by fifteen-percent and horizontal fiber density is reduced by thirty-percent.

D. each such semi-rigid batten having one or more variable density batten zones proximate to rig contact points in which zones batten rigidity is reduced by fifteen-percent;

E. each such external batten reduction combination having a collective rigidity level approximately equal to that of the collective rigidity level of the respective batten and batten pocket it replaces;

33. The sail system of claim 3 with the follow distinguishing or additional properties:

A. one or a plurality of integral batten substitutes, each such integral batten substitute comprising a combination of diagonal or vertical fibers and horizontal fibers mechanically or chemically integrated with the sail in the axis of a replaced batten and batten pocket;

B. said fibers having a density ratio of approximately two diagonal or vertical fibers to one horizontal fiber;

C. each such integral batten substitute having one or more variable density zones proximate to rig contact points and sail folding points in which zones vertical or diagonal fiber density is reduced by fifteen-percent; and horizontal fiber density is reduced by thirty-percent;

D. each such batten substitute having a collective rigidity level approximately equal to that of the batten and batten pocket elements it replaces;

whereby a new use of existing fiber-orientation-sail-making-technology yields batten-free, overlapping semi-elliptical hoisted mainsails with self-supported positive roach.

34. The sail system of claim 1, with the following distinguishing or additional properties:

A. a plurality of battens;

B. a topping lift;

C. a downhaul;

D. a single-line reefing system comprising cordage, pulleys and fairleads;

E. a deployment control configuration comprising a plurality of control lines; a first end of each such control line being attached equidistantly along the foot of said sail; a second end of each such control line passing upwards through fairleads attached equidistantly to said sail along a corresponding axis parallel to the luff of said sail; each such control line exiting said sail approximately five centimeters from its luff then connecting to the sail's topping lift;

whereby a non-overlapping, self-tacking, self-boomed hoisted headsail combines maximum- area-semi-elliptical shape with comprehensive cockpit sail control.

35. The sail system of claim 2, wherein the sail integrates the following distinguishing or additional features:

A. a plurality of battens;

B. a topping lift;

C. a downhaul;

D. a single-line reefing system comprising cordage, pulleys and fairleads;

E. a deployment control configuration comprising a plurality of control lines; a first end of each such control line being attached equidistantly along the foot of said sail; a second end of each such control line passing upwards through fairleads attached equidistantly to said sail along a corresponding axis parallel to the luff of said sail; each such control line exiting said sail approximately five centimeters from its luff then connecting to the sail's topping lift;

whereby an overlapping, self-tacking, self-boomed hoisted headsail combines maximum-area-semi-elliptical shape with comprehensive cockpit sail control.

36. The sail system of claim 3, with the following distinguishing or additional properties:

A. a plurality of battens;

B. a topping lift;

C. a downhaul;

D. a single-line reefing system comprising cordage, pulleys and fairleads;

A. E. a deployment control configuration comprising a plurality of control lines; a first end of each such control line being attached equidistantly above the foot of said sail along a horizontal axis between the clew and luff of said sail; a second end of each such control line passing upwards through fairleads attached equidistantly to said sail along a corresponding axis parallel to the luff of said sail; each such control line exiting said sail approximately five centimeters from its luff then connecting to the sail's topping lift;

whereby an overlapping, self-boomed hoisted mainsail combines maximum-area-semi-elliptical shape with comprehensive cockpit sail control.

ABSTRACT

A comprehensive, universally compatible System of hoisted semi-elliptical mainsails and self-tacking headsails reconciling optimum sail performance with optimum safety and convenience. Non-overlapping Maxjib (28), overlapping Maxjib (26), and self-boomed Maxmain (30) are self-boomed, self-tacking hoisted sails that incorporate both predetermined maximum roach parameters and embodiment-specific semi-rigid batten layouts. External-spar Maxmain (32) extends System benefits, including predetermined maximum roach overlap perimeters, to boomed mainsail configurations. External batten reduction and integral batten substitution configurations as well as headboard-end plate combinations produce synergism of result for all System sail embodiments. Usable in various combinations, System sail embodiments enable self-boomed, overlapping mainsails and self-boomed, overlapping self-tacking headsails, thus making available optimized, cost-effective sail power for both recreational and commercial users of wind-powered vehicles.

SEQUENCE LISTING

not applicable

#11 / drawings
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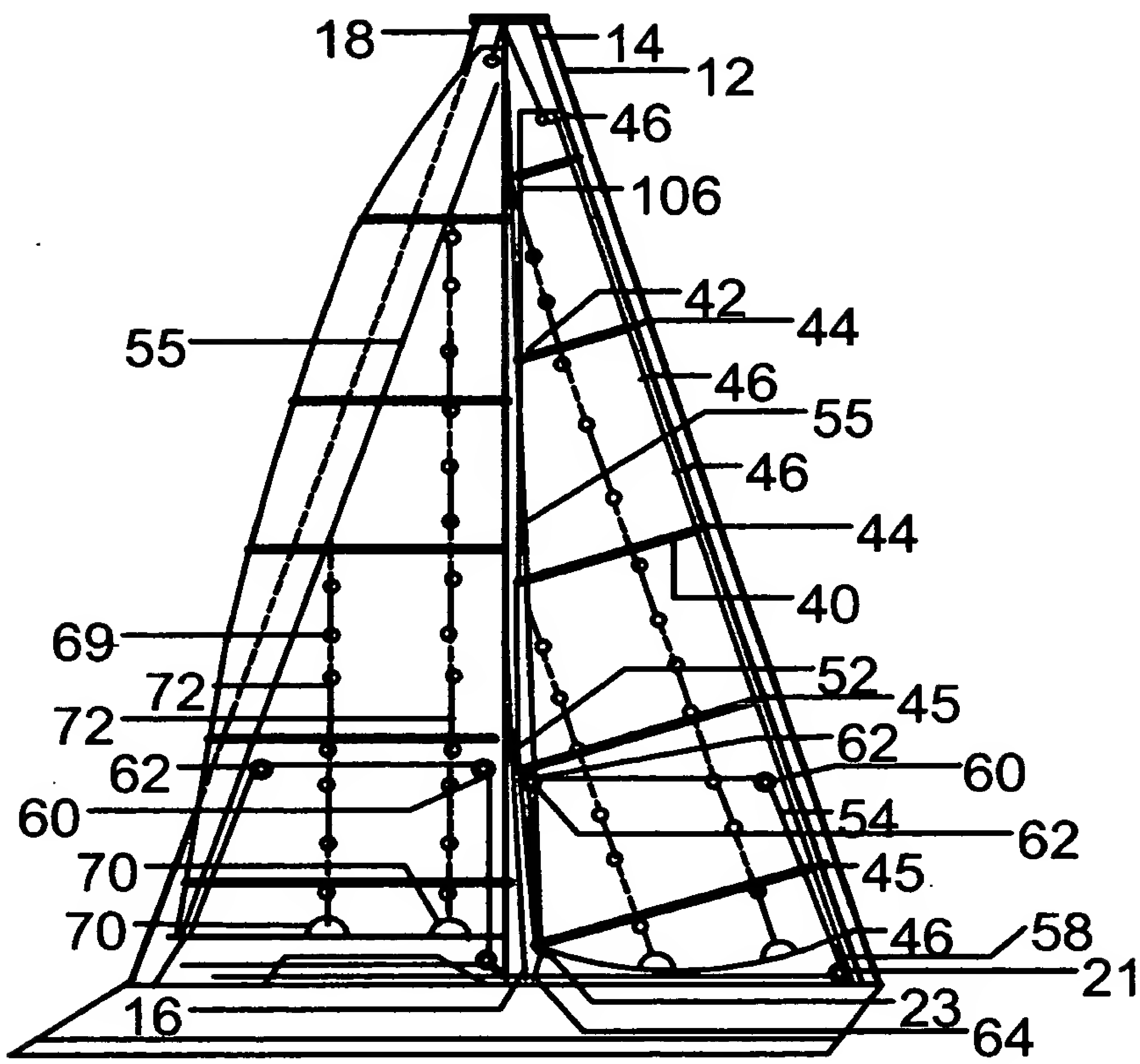
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FIG. 1

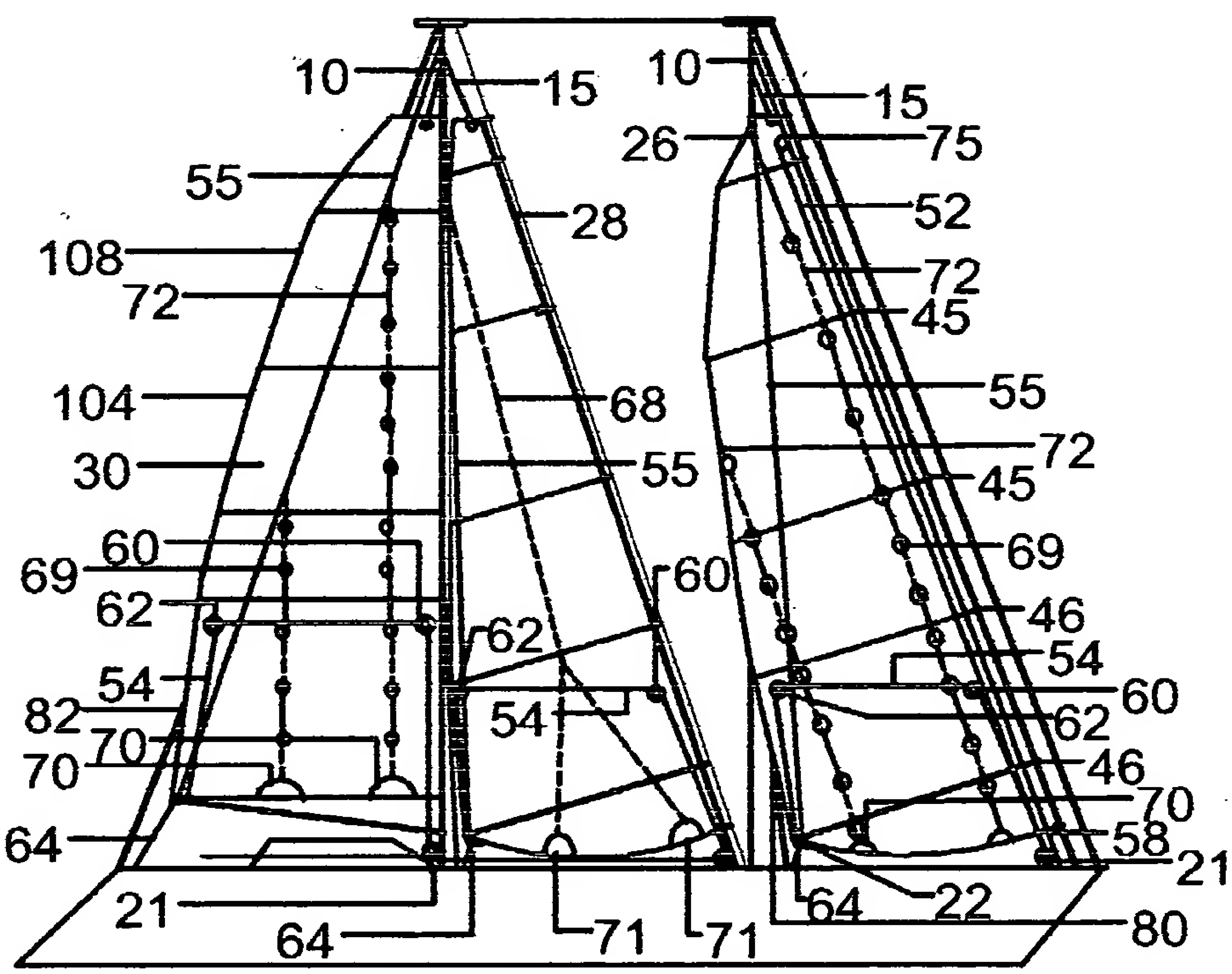
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Fig. 2

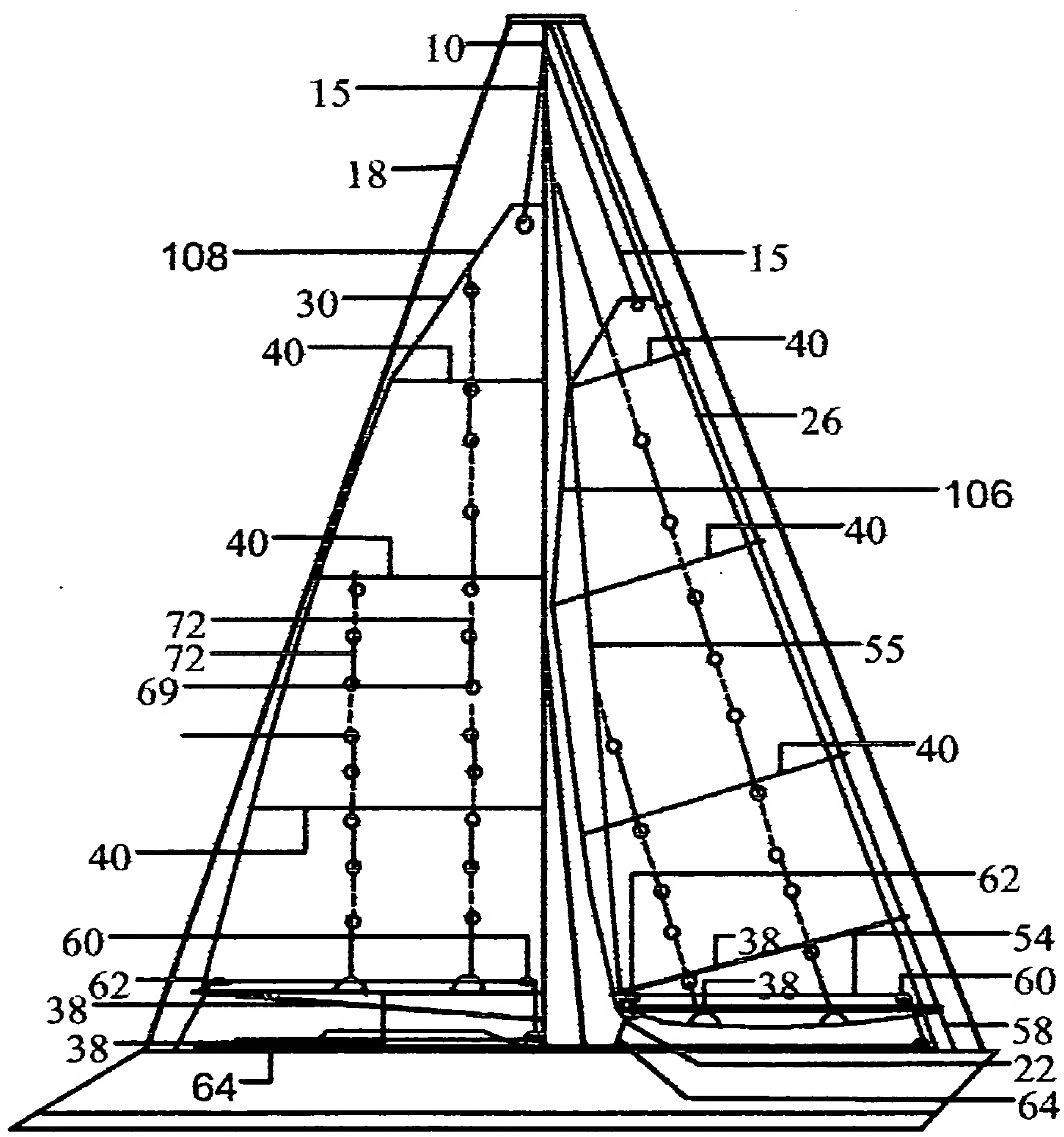
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Fig. 3

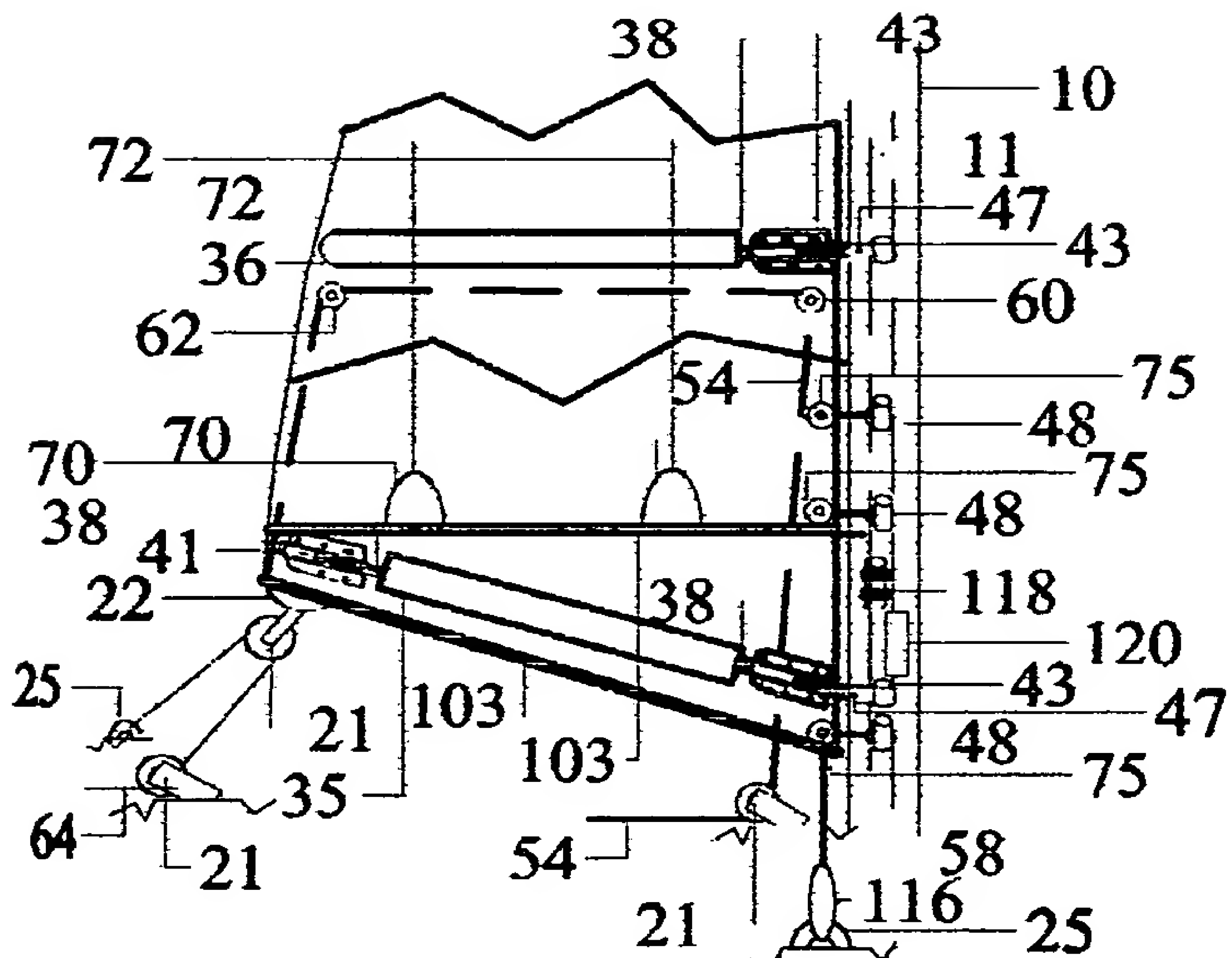
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Fig. 4

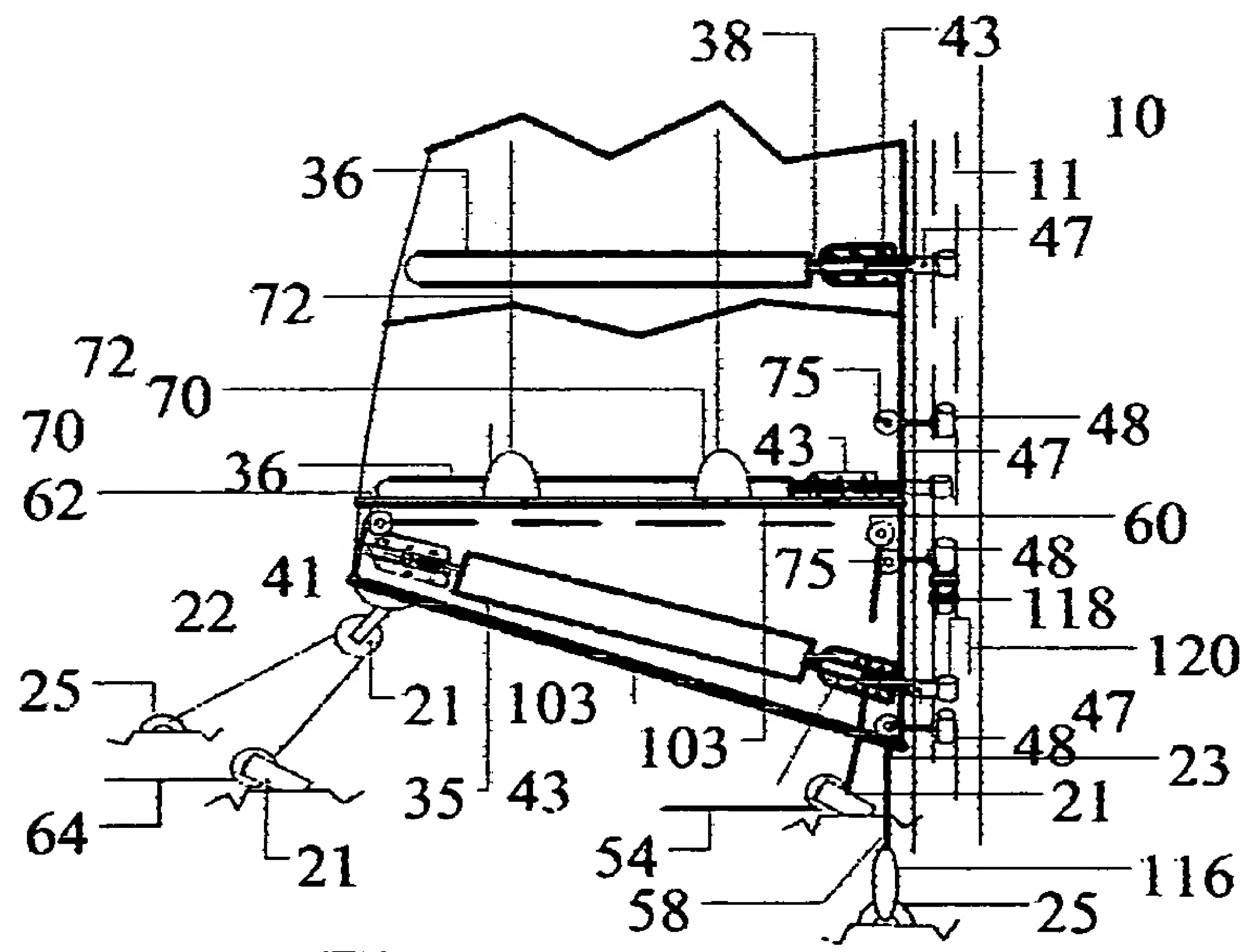
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Fig. 4a

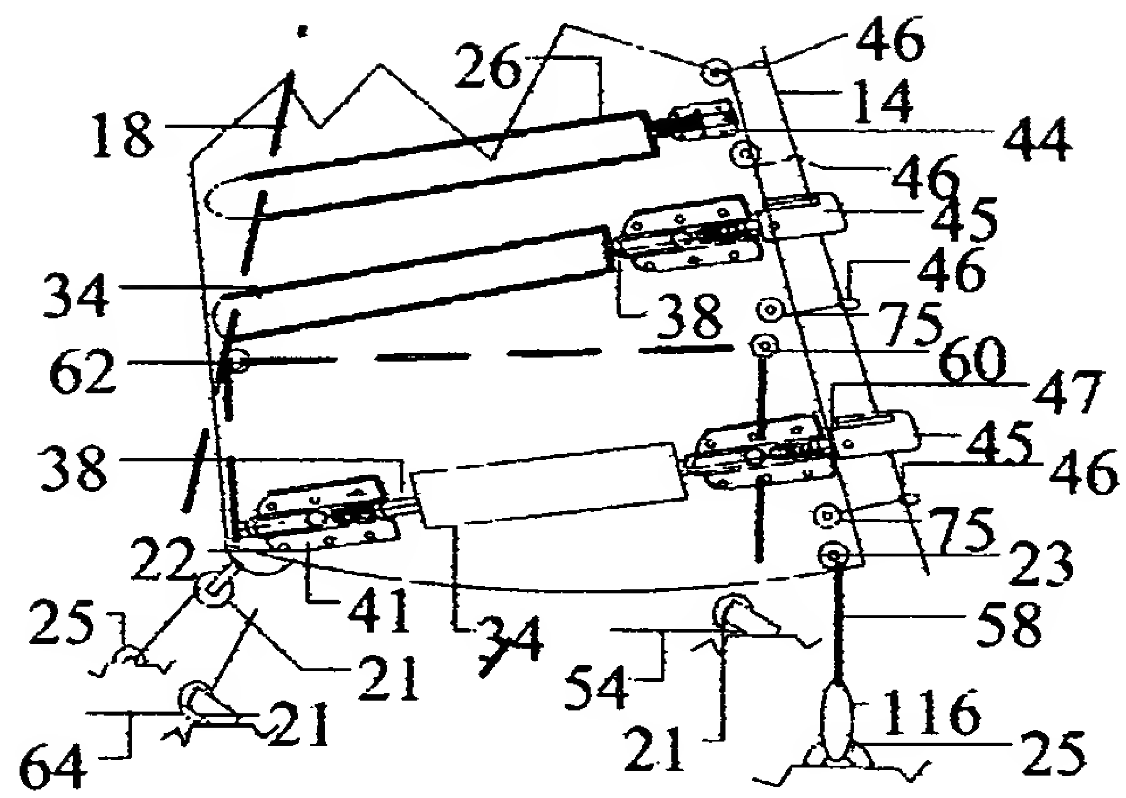
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Fig. 5

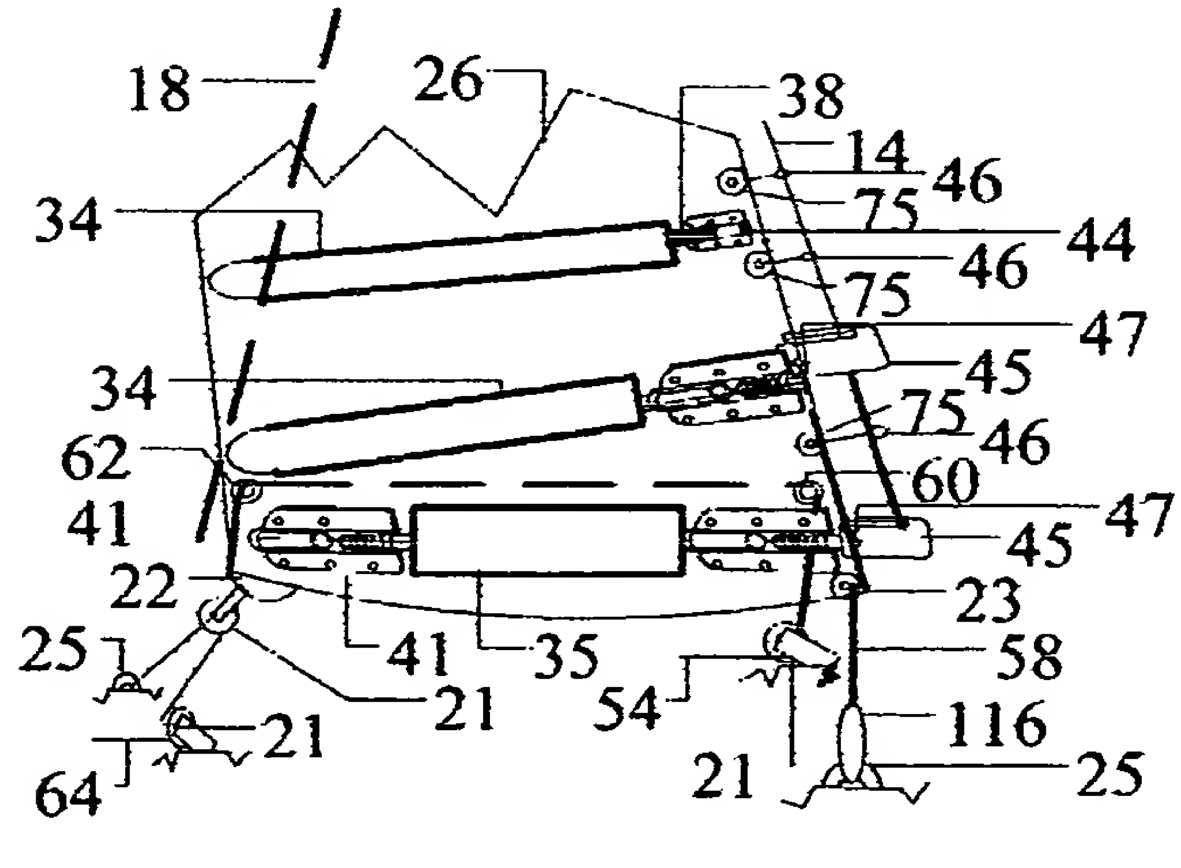
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Fig. 5A

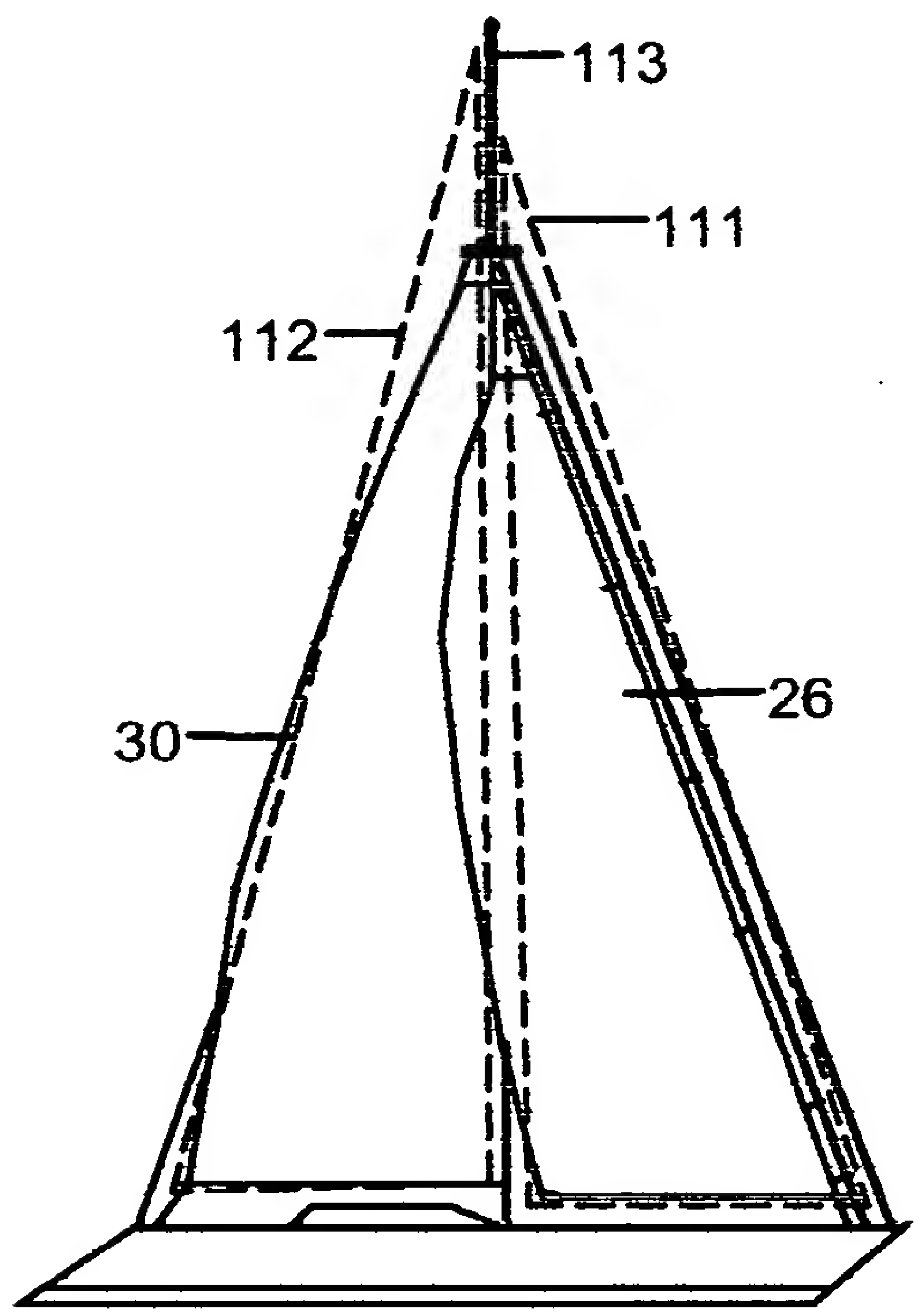

Fig. 6

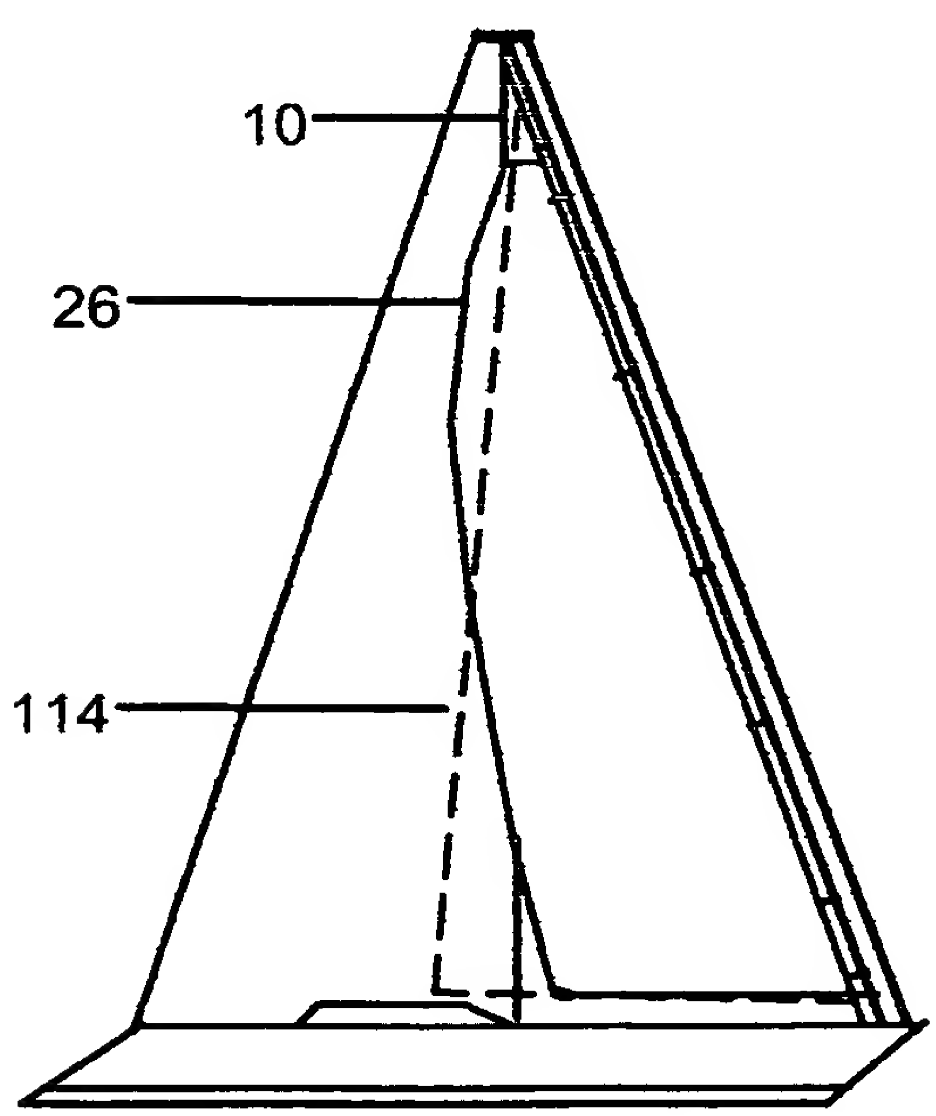

Fig. 6a

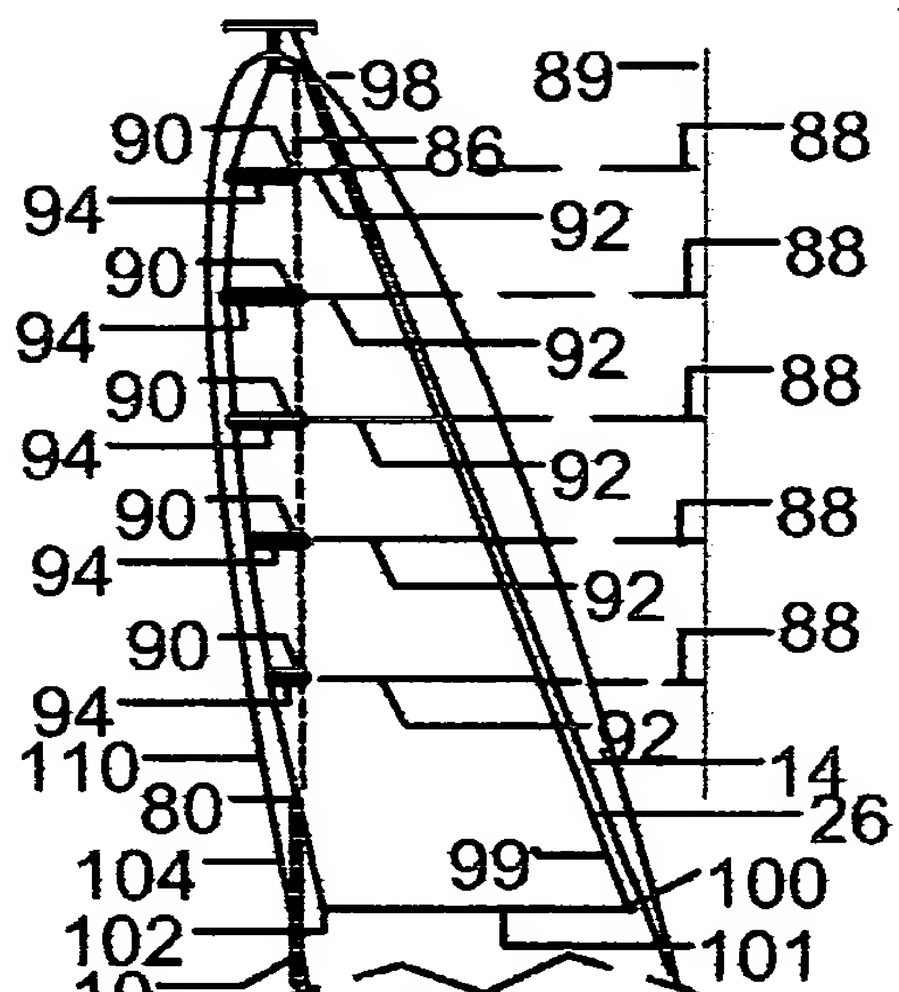

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Fig. 7

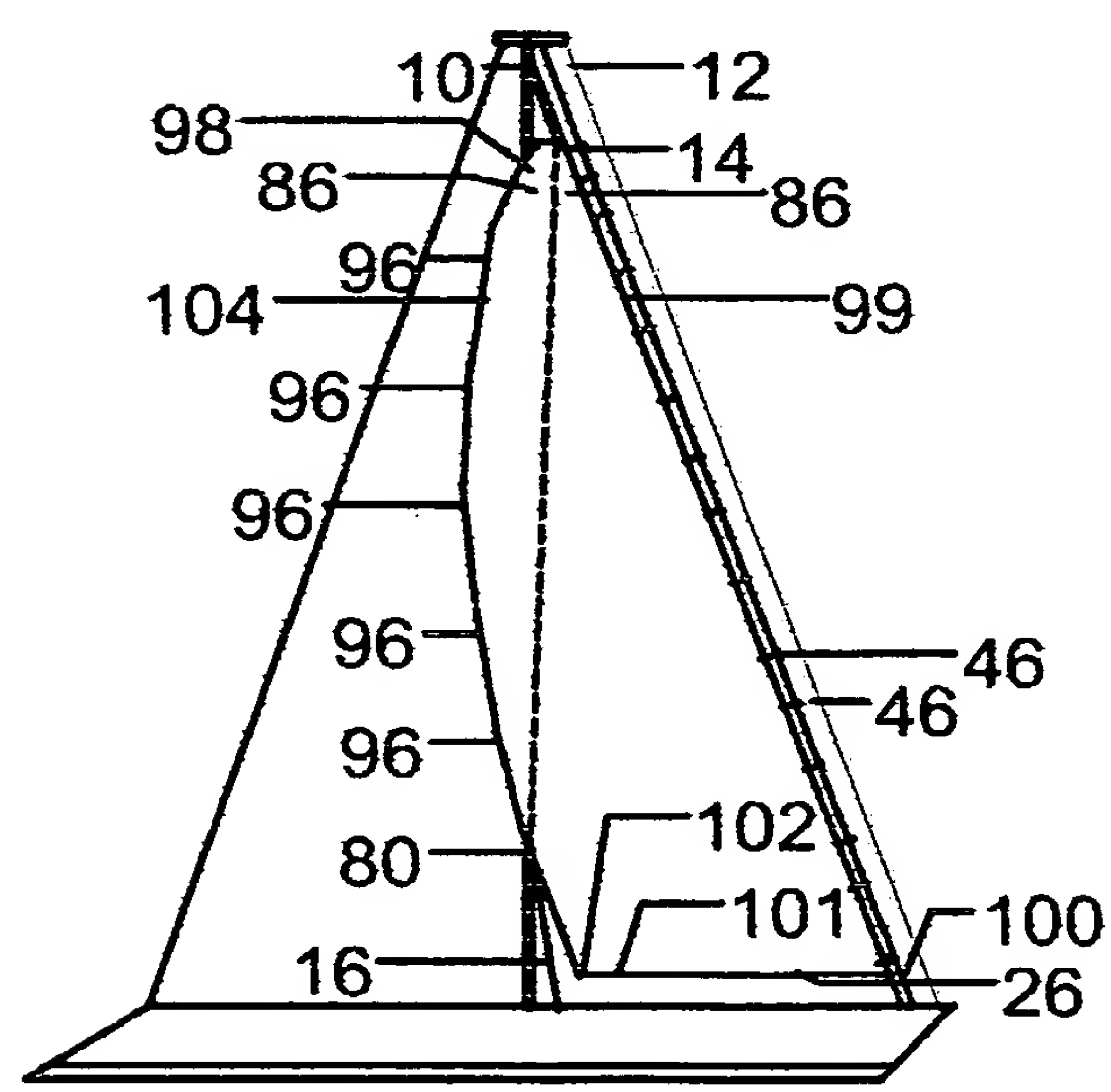

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Fig. 7a

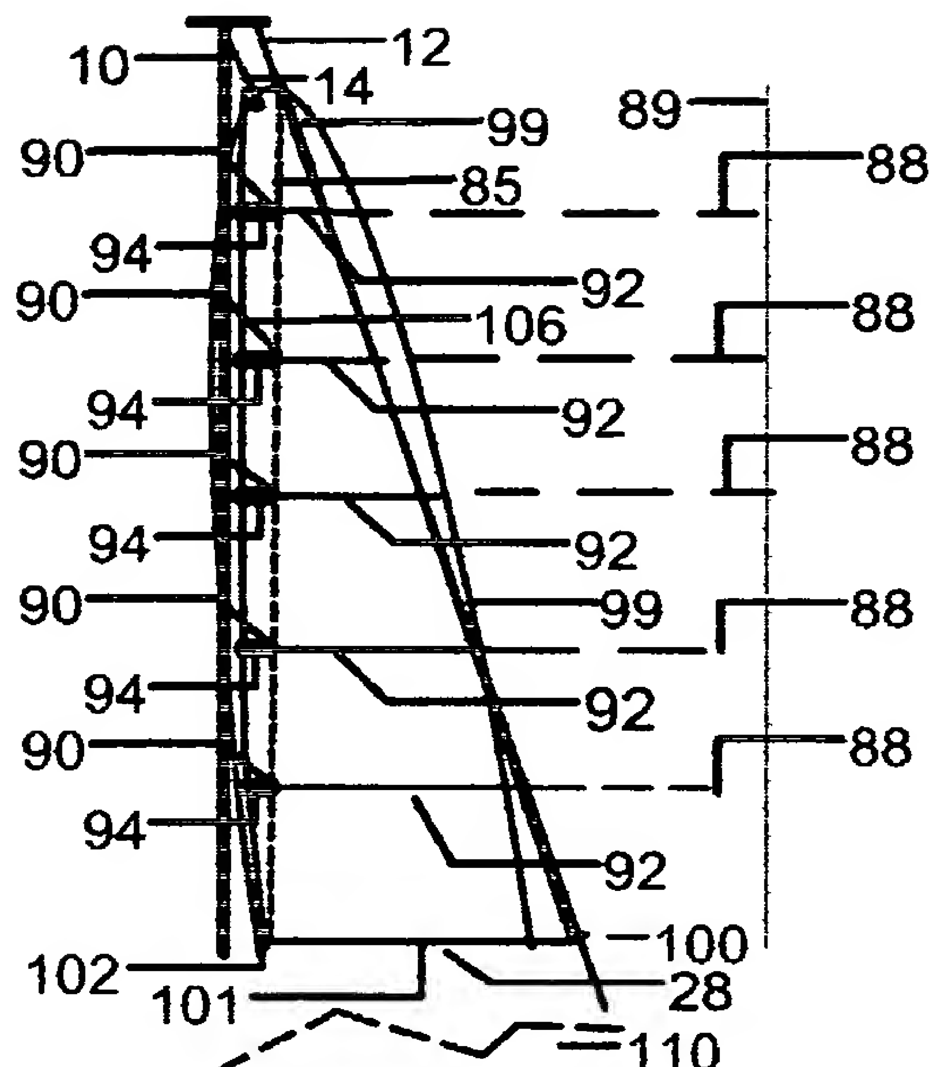

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FIG. 8

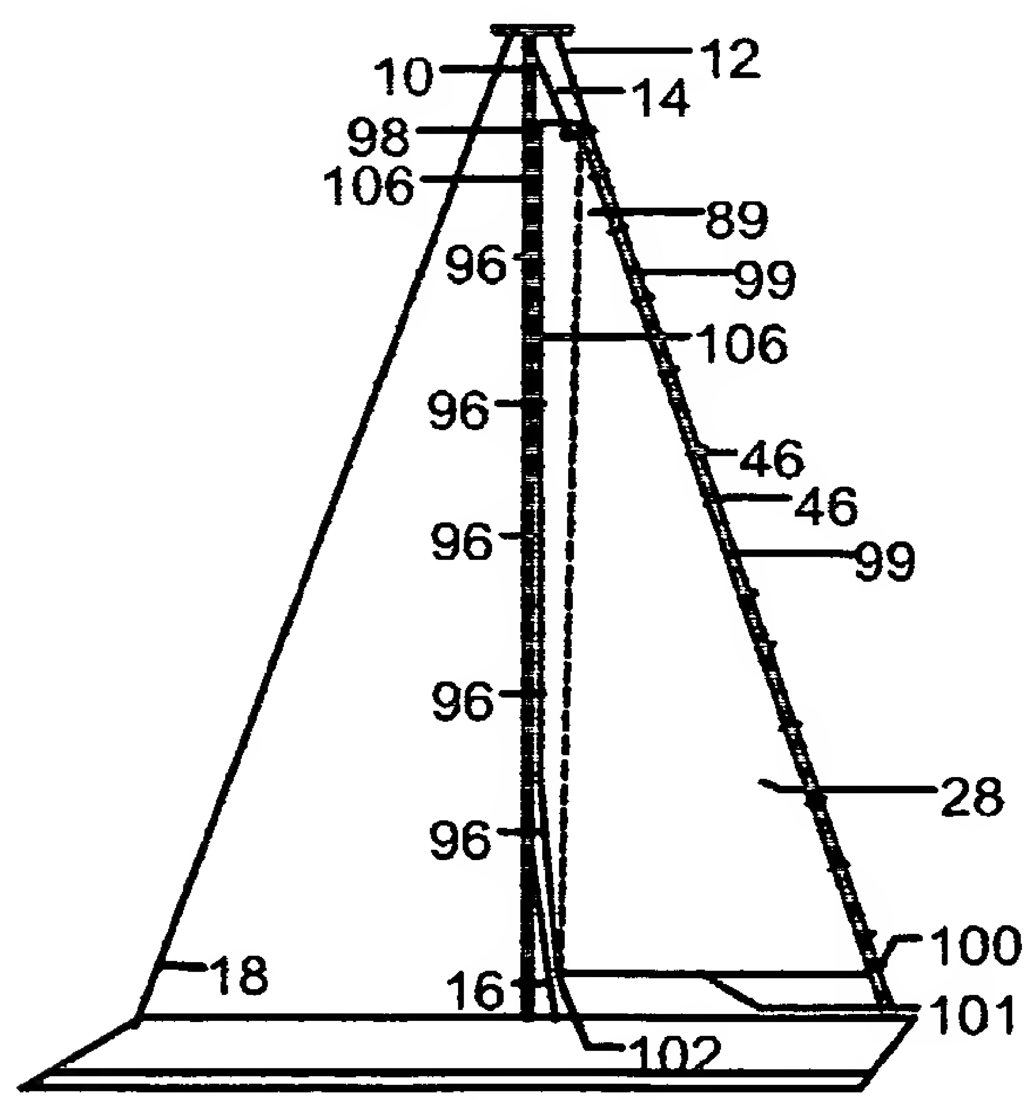

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FIG. 8a

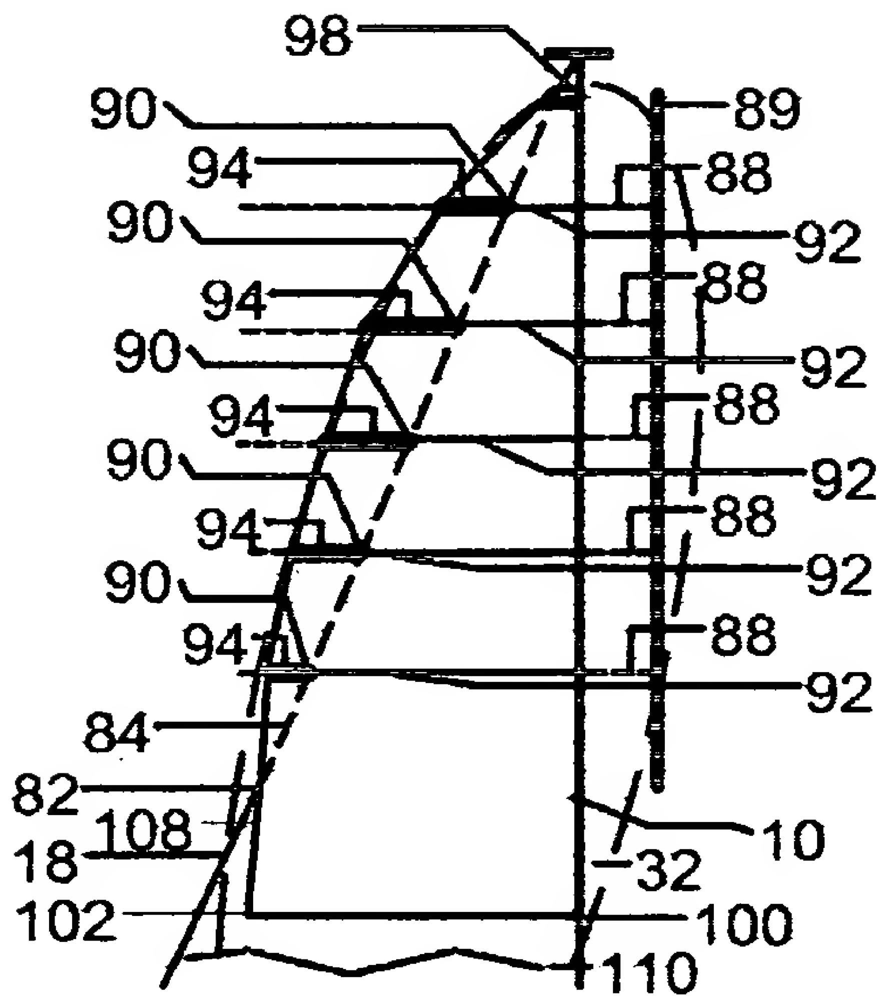

Fig. 9

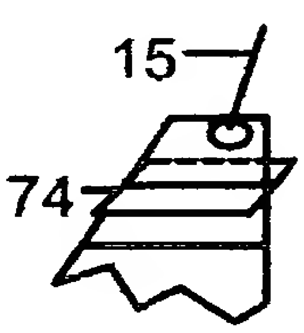

Fig. 9b

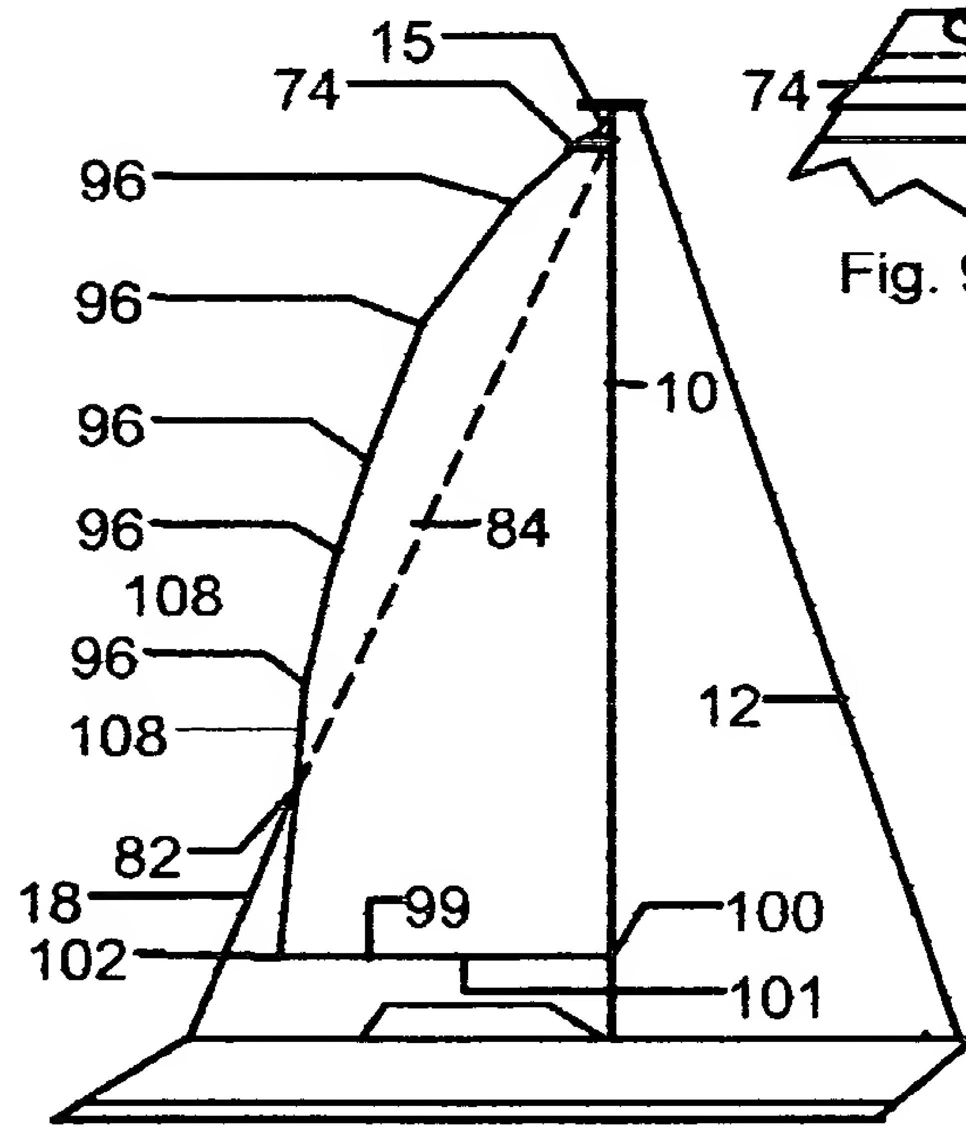

Fig. 9a

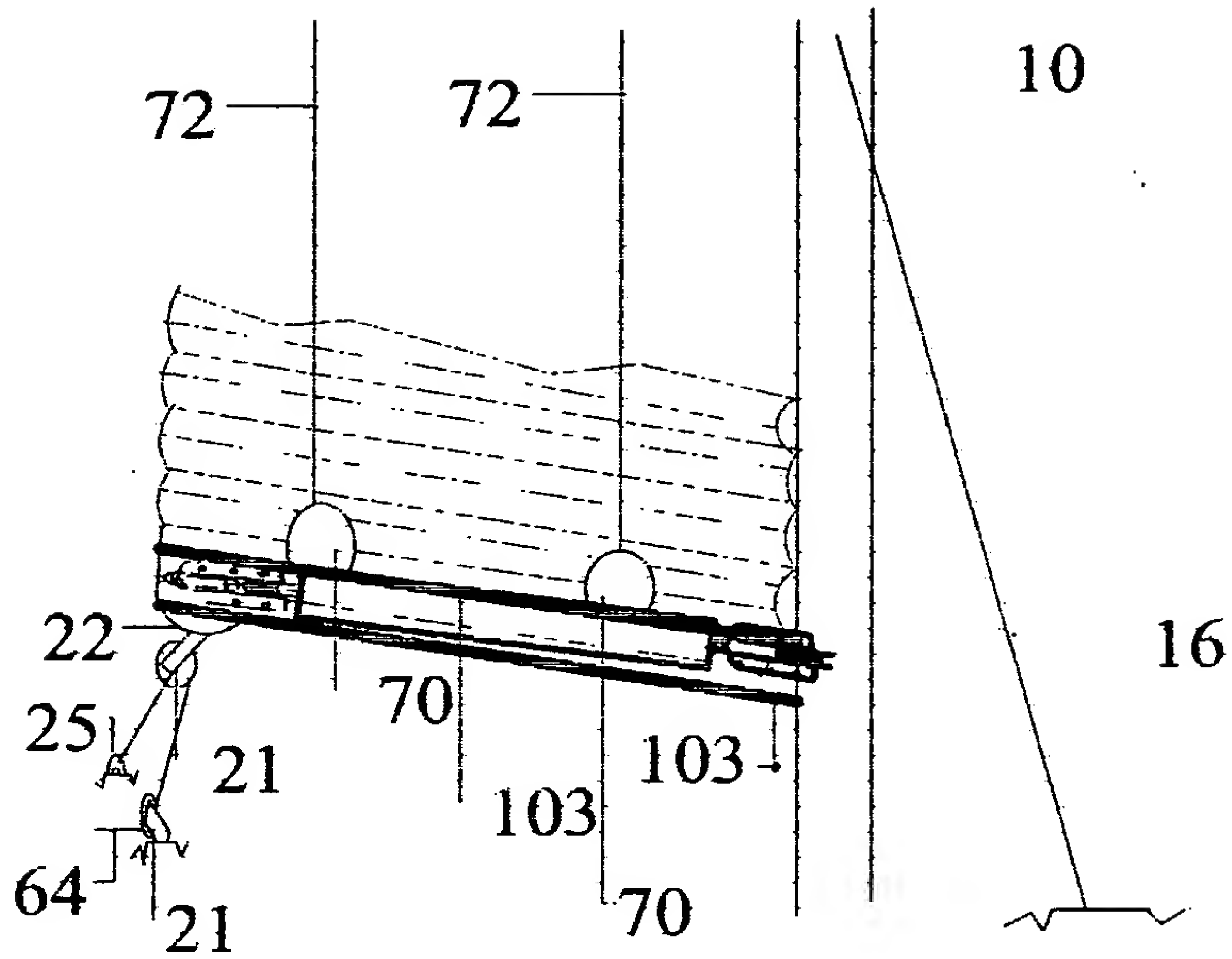

FIGURE 10

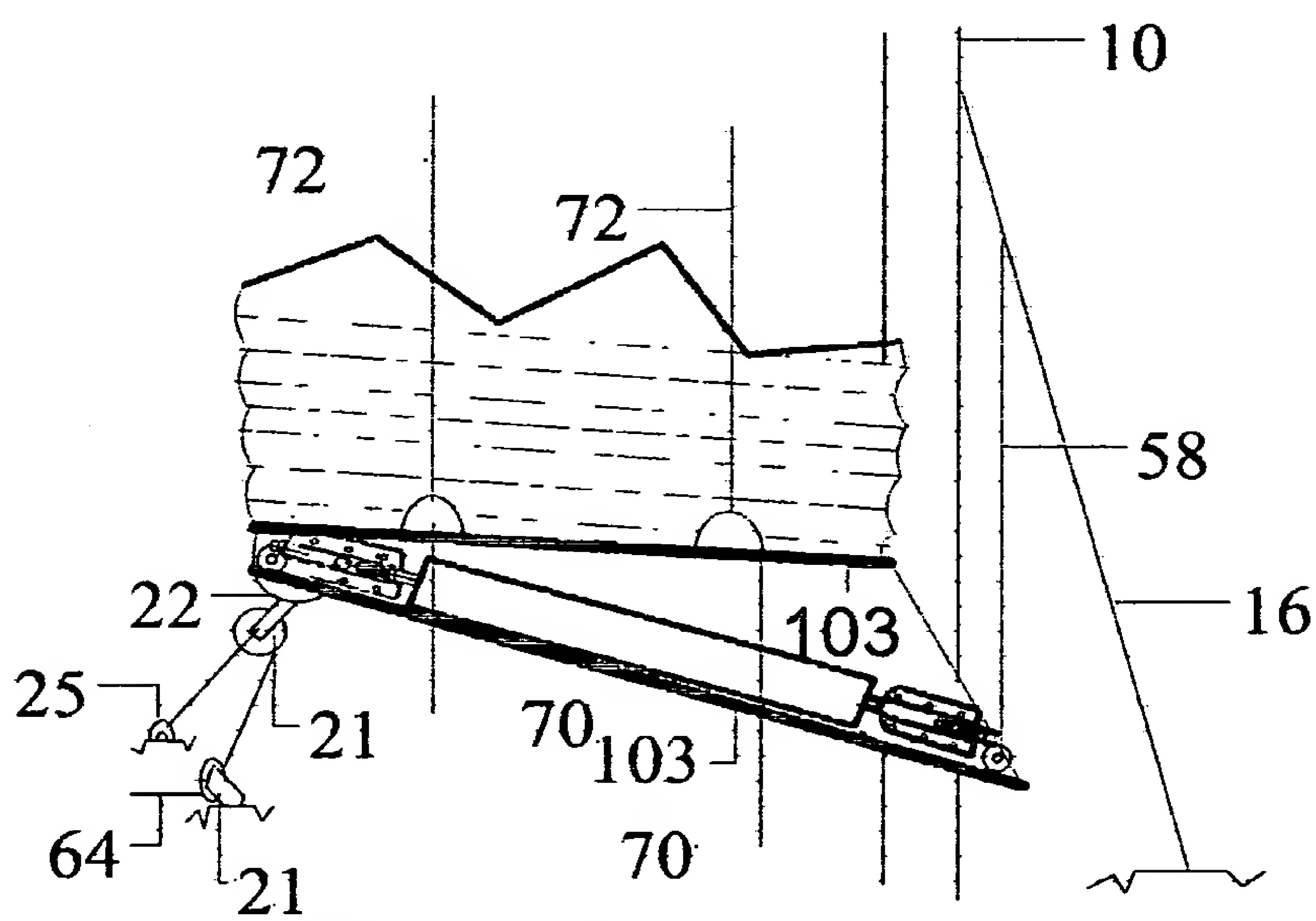

FIGURE 10a

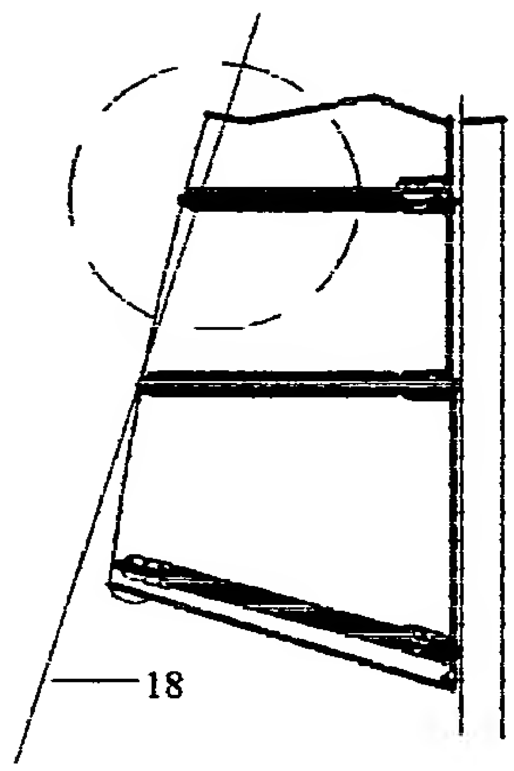

Fig. 11

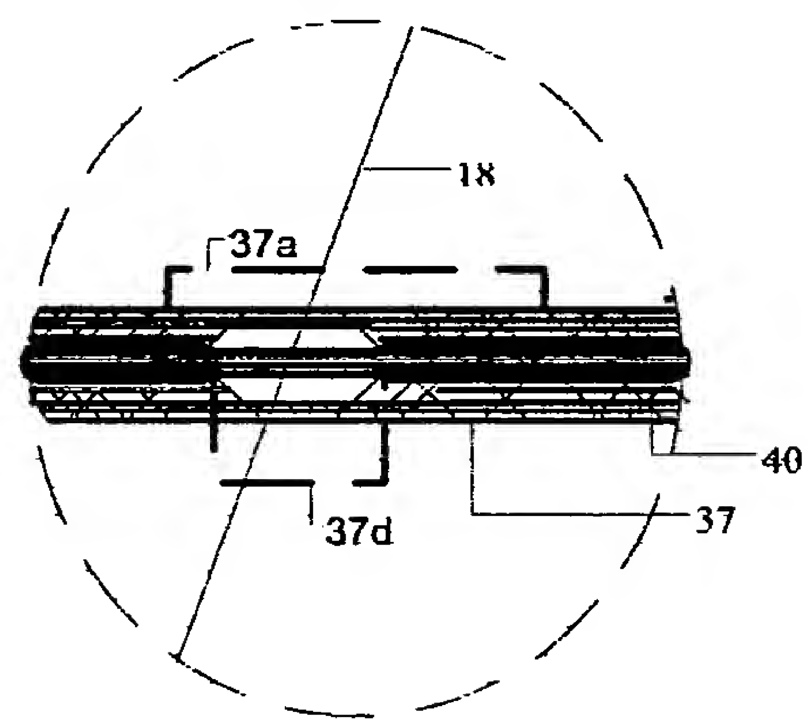

Fig. 11a

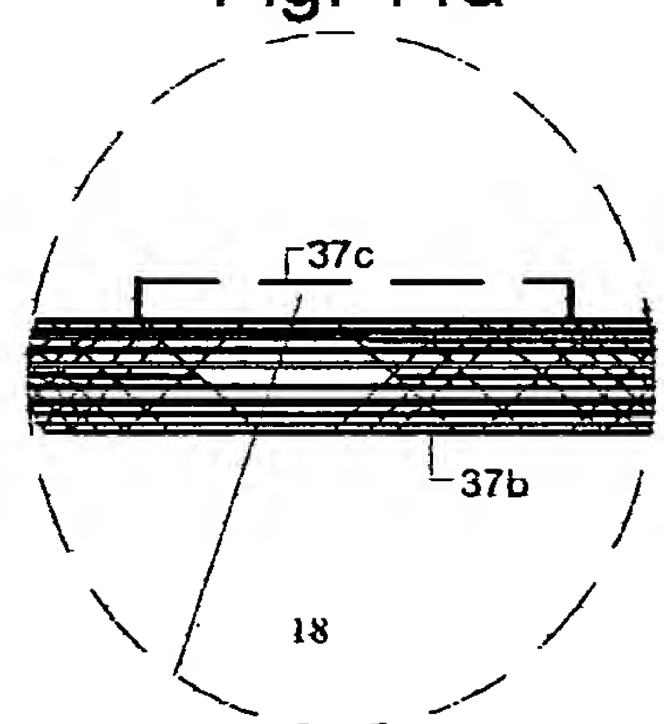

Fig. 11b

#11 10 9/18/03

Please review for entry

Sub spec not approved

RESPONSE TO FIRST OFFICE ACTION DATED SEPTEMBER 13, 2002

Assistant Commissioner of Patents
Washington, District of Columbia 20231

Sir:

In Response to an Office Letter dated June 11, 2002, entitled Election/Restriction", Applicant elected to restrict his Application, Serial Number: 09/781,167, to Claims 2 and 7-12, which pertained to overlapping <u>and</u> non-overlapping vertically deployed sails.

A First Office Action dated September 9, 2002, and mailed September 13, 2002, objected to the Specification, Drawings, and Claims of the restricted Application. The attached **Amendment A** responds to the specific Objections of the First Office Action. The Amendment contains a substitute Specification, substitute Drawings and substitute Claims.

Substitution, as opposed to partial revision of the original Application, best serves clarity and ease of examination. The original Application was drawn to sail configurations that grouped hoisted and furled sails together. As such, It was not possible to isolate the elected, hoisted-sail-elements of the original Application from the non-elected furled-sail-elements by lining out parts of the Specification or by partially modifying the original Drawings. Therefore,

Petitioner was obliged to prepare entire substituted Specification, Drawings and Claims.

Amendment A addresses editorially errors of form noted by the Examiner and also overcomes all technical Objections, thus defining the invention patentably over the prior art. Accordingly, in response to the First Office Action dated September 9, 2002, please amend the abovementioned original Application as follows:

Title: Change to - Universally Compatible, Vertically Deployed Semi Elliptical Sail System for Wind-Propelled Vehicles.

Specification:

Replace pp. 1 – 88 of original Application with pp. 1-122 of Amendment A.

Claims:

Cancel all Claims of record and substitute new Claims 21-36 of Amendment A.

Drawings:

Replace all drawings of record and substitute attached drawing sheets 1 –11, comprising Figures 1 – 11b.

<u>Remarks - General</u>

A First Office Action objected to Applicant's elected Claims, Specification and Drawings as being obvious, and for failing to explain adequately how to make and use the invention. In compliance with the first Office Action, Amendment A limits its scope to vertically deployed, or "hoisted" sails and offers no new material.

Applicant's Amendment A discloses <u>diverse new and unexpected results</u> produced by his invention and how to <u>Make and Use</u> each System embodiment as to allow one skilled in the art to which the Application pertains, or is most nearly connected, to make and/or use the invention.

A. Before addressing specifically each Objection of the First Office Action, Applicant respectfully submits that the following rationale responds to the substantive Objections of the First Office Action and establishes that Petitioner's invention is unobvious and patentable. The prior art referenced in the First Office Action does not pertain to the subject matter of the Applicant's System. The following discussion is devoted to proving three points:

   1) The subject matter of Applicant's System pertains to new types of **sails** that produce new and unexpected results;
   2) The referenced patents are **not** about sails, but about booms or deployment control devices.
   3) **No referenced patent** or its prior art in any way anticipated or made obvious any aspect of Applicant's claims.

<u>THE SUBJECT MATTER OF APPLICANT'S SYSTEM IS ENTIRELY DISTINCT FROM THAT OF PATENTS REFERENCED IN THE FIRST OFFICE ACTION</u>

The text and drawings of patents referenced in the First Office Action, or the **"referenced patents"** disclose subject matter distinct from the subject matter of Applicant's Amendment A. Detailed "Responses to Specific Objections of the First Office Action" are set forth following the <u>summary reviews of referenced patents</u>, which are set forth immediately below:

A. Two of the referenced patents, Marechal and Moessnang, disclose boom-contained mechanisms for rolling or "furling" a mainsail into the body of a rigid boom. Neither patent nor its respective prior art pertains to or makes obvious the subject matter of Applicant's System.

1) <u>Marechal and Moessnang pertain to boom-contained furling mechanisms,</u> whereas <u>Applicant's System produces its new and unexpected results without resort to either a boom or a furling mechanism.</u> In a context of **primary physical description**, neither Marechal nor Moessnang teach, disclose, or infer anything that would render Applicant's System obvious or unpatentable.

2) In an **operational context**, the Marechal and Moessnang booms accomplish mainsail stowage by means of a furling **mechanism** that mechanically reduces a mainsail to a rolled or **"furled"** configuration. **Positive energy** from a human, electrical, or hydraulic source is <u>indispensable</u> to operation of the furling mechanisms disclosed by Marechal and Moessnang.

B. Contrarily, Applicant's system mainsails and headsails **stow** to a folded or **"flaked"** configuration **without resort to any mechanism** whatever . Where furling booms require positive energy for sail

stowage, Applicant's System **passively** stows sails by virtue of the force of gravity.

C. Marechal and Moessnang pertain exclusively to means for stowing sails in a rolled configuration, whereas Applicant's System consists of sails that are stowed in a folded or "flaked" configuration. **In a context of mechanical operation and results**, neither Marechal nor Moessnang teach, discloses, nor infers anything that would render Applicant's System obvious or unpatentable.

2. Another referenced patent, <u>Van Breems</u>, discloses a sail deployment control device for a sail that has **horizontal battens**, and that is **attached to a boom**. Applicant's Amendment A specifically cites the Van Breems patent and identifies the Van Breems device as being a patented item that appears as an <u>optional</u> item on the parts list for Applicant's System. Stated otherwise, a deployment control device, whether patented or non-patented, merely complements the System, which independently produces new and unexpected results.

3. A control deployment device is a generic component of Applicant's System in the same sense that sailcloth and thread are generic System components. (see Amendment A, pp.26 and 61). Use of a Van Breems device in a preferred embodiment is but one of three alternatives. A second alternative would employ any of a wide variety of lazy jack devices, and a third would eliminate a deployment control device entirely. Such alternate approaches enable broader marketing objectives.

4. Applicant's System produces its diverse new and unexpected results **independent of <u>any</u> deployment control device** whatever. Use of a

deployment control device simply **complements** the System without derogating in any way from its new and unexpected results.

5. Notwithstanding, Applicant submits that his particular use of the Van Breems device was **unforeseeable by its inventor** because the Van Breems device was strictly limited to boomed sails with horizontal battens.

   A. Van Breems in no way anticipated Applicant's connection of the device at a level **above** the foot of a self-boomed mainsail **30** with a downward-oriented bottom batten (see Amendment A, p. 61, and Figure 4).

   B. **In a context of primary physical description**, therefore, Applicant's task-specific use of a deployment control device in connection with diagonally battened sails that dispense altogether with an external boom is clearly outside any use foreseen by Van Breems.

C. In an **operational context**, uniform support of the foot of a self-boomed sail with diagonal battens to facilitate single-line reefing was in no way foreseen by Van Breems. Accordingly, such use of the Van Breems device constitutes a further unforeseeable use of a known device that produces new and unexpected results.

In summary, the System's several new and unexpected results are entirely **independent** of either the patented Van Breems device or diverse non-patented deployment control devices such as lazy jacks. Elimination from the System of a deployment control device altogether would not diminish its diverse new and unexpected results, nor should such elimination affect patentability over the prior art. Notwithstanding, Applicant's use of the Van Breems device is an unforeseeable, new use that leads to new and unexpected results.

Below, Applicant reviews the specific language and drawings of the referenced patents and other rigid boom patents, illustrating that none of them taught, inferred or made obvious any of the novel aspects or results of Applicant's System.

THE ONGOING COMMANDMENTS OF SAIL MAKING

Sail designers have adhered systematically to interdictions, or "commandments" based on accepted physical principles. Several of those commandments pretend to condemn as unfeasible precisely the results Applicant's System has reduced to practice:

1. A self-tacking sail cannot reliably and safely tack or jibe if its leech overlaps a companion rig element (See Amendment A, p.19, 22).

2. Separate port and starboard sheets are absolutely indispensable to tacking and jibing any sail that overlaps its companion rig triangle (See Amendment A, p.20).

3. Only a rigid external spar can adequately maintain the foot of a mainsail or self-tacking jib in horizontal extension against the force of the wind and against the inward reef line forces imposed by single-line reefing configurations. (See Amendment A, p. 22).

AMENDMENT A DISCLOSES A NOVEL INVENTION THAT PRODUCES NEW AND UNEXPECTED RESULTS

Amendment A discloses a novel invention that unexpectedly **transcends** the above commandments of sail making, **rendering them obsolete**. In achieving such a remote and unimaginable result, Applicant's System introduces entirely new sail types, each of which produces new and unexpected results (see Amendment A p. 53).

Certainly, Applicant did not invent the "obvious design consideration [s]" or "obvious choice[s] of design" referenced in Objection 8 of the First Office Action. Applicant respectfully submits that his reference to known concepts or categories such as "relative size", "material of construction", or "color" describes or relates information about the **infrastructure** of his System as opposed to stating a claim relative to any such concept or category.

The addition of a highly visible color, for example, to an otherwise unobvious combination of known or novel components can **complement** the **independently unobvious results** of that combination without in any way detracting from its patentability. For example, complementing the unexpected economic, safety and performance results of a headboard-end plate combination **74** with a highly visible color in no way effaces thee combination's independent, unexpected results.

An invention can produce novel unexpected results and synergism independent of its color. For example, painting or otherwise endowing an invention's surface with reflective properties and a red color would not obviate the patentability of a novel, **uncolored** counterpart that produced new and unexpected results. The colored, reflective surface would **complement the utility** of the combination.

Even if such reflective coloration were assumed to be obvious, application of such properties to an invention that independently produces new and unexpected results should in no way detract from such independent results or the invention's patentability. Applicant submits that once a novel device produces new and unexpected results, complementing its functions or marketability should in no way impact its patentability.

Conversely, an unforeseen use of a known device to produce new and unexpected results should be considered unobvious and in no way an impediment to patentability. Applicant's use of the Van Breems and other deployment control devices presents just such a case. Consequently, it is useful to apply a **two-tier analysis** to known elements of an invention to determine whether any such element even appears to counter patentability:

A. Is the addition of a known element to an independently unobvious invention merely a **complement** to that invention, as opposed to a requisite, **inextricable** element of that invention?

B. Is the known element used in a new, unforeseen way?

An **affirmative answer to either or both** of the above confirms that use of the element in question should in **no way detract from or efface patentability**.

APPLICANT'S SYSTEM REDUCES TO PRACTICE UNIVERSAL COMPATIBILITY BETWEEN OVERLAPPING SEMI-ELLIPTICAL SAILS AND CONVENTIONALLY RIGGED SAILBOATS

Applicant does not claim to have invented the "relative size" of triangular and semi-elliptical counterpart sails. Rather, Applicant's System introduces predetermined maximum roach parameters that enable an unexpected and universal reconciliation of overlapping semi-elliptical sail profile with the rig geometry of any sailboat. That specific result was in no way obvious to one ordinarily skilled in the art. To the contrary, those ordinarily skilled in the art still consider that result unfeasible (see Amendment "A" p.16).

APPLICANT'S SYSTEM CONVERTS A NEGATIVE, ABSOLUTE DESIGN BARRIER TO A POSITIVE, SYNERGISTIC DESIGN THREHSOLD

1. A side view of any conventionally rigged sailboat shows a mast and rigging wires that delimit fore and aft right-angle rig triangles. Designers have systematically drawn mainsails and self-tacking headsails as smaller, interior sail triangles, **thus avoiding sail-to-rig contact**

2. "**Obviously**", reasoned designers, "a sail that can hang up on or bang against intervening rig elements can never safely or reliably tack or jibe and will quickly self-destruct".

3. **Unobviously**, and by virtue of that very contact, not in spite of it, Applicant's sail System provides new and unexpected performance and safety results. This unexpected, highly beneficial use of sail-to-rig contact was in no way made obvious by prior art. In fact, such a conversion sail-to-rig contact from a prohibition to an important performance and safety asset **diametrically opposes design convention and prior art**.

4. Thus, Applicant's System is **unobvious** for its **conversion of a negative** geometric design barrier **to a constant source of positive** functional, marketing, and economic results.

5. Applicant's System reduces to practice diverse results deriving from what heretofore has been accepted as an obvious physical and geometric impossibility. As such, the System produces new and entirely unexpected results.

Results that derive from recycling an **absolute design barrier** into a **synergistic design threshold** are, above all, new and unexpected.

APPLICANT'S SYSTEM ACCESSES ENERGY HERETOFORE UNAVAILABLE FOR MAINSAILS AND SELF-TACKING HEADSAILS

1. Inevitably, contact between the leech of a sail and companion rig elements gives rise to an accumulation of energy. Heretofore, using that energy to hold a sail "aback" in order to assist a boat's passage through a tack or jibe, was possible **only** if crewmembers alternately released and tensioned separate port and starboard sheets, as in the case of a genoa headsail. There was no safe or practical way to hold a self-tacking sail aback

2. Applicant's system enables mainsails and self-tacking headsails to **momentarily** remain "aback" then tack or jibe automatically **without** crew intervention. The release of stored energy as a System sail crosses a companion rig element accelerates a boat through the axis of the wind as it completes a tack or jibe. Heretofore, this was possible only with sails controlled by separate port and starboard sheets alternately tensioned and released by crewmembers. First, the ability to hold a sail controlled by a single sheet aback is new and unexpected.

3. Second, the fact that the head area of a self-tacking sail can replace crew intervention to automatically release the energy of a sail held aback at the right moment is new and unexpected. System sails use heretofore-inaccessible sail-to-rig-contact-energy to **optimize** tacking and jibing.

4. The System's advantageous use of obviously negative geometric relationships and obviously inaccessible physical forces is as **improbable** as a comic strip character walking through a brick wall, or a magician sawing a woman in half.

5. In large part, the "magic" of Applicant's System lies in its unique combination of innovative self-booming diagonal batten layouts and predetermined maximum roach parameters to enable overlapping, semi-elliptical mainsails and self-tacking headsails. Heretofore, universal compatibility for such innovations has remained inconceivable.

6. In sum, it suffices to say that self-boomed, overlapping System sail embodiments **constitute entirely new sail types that produce entirely new and unexpected results** (see Amendment A, pp. 51-53).

PROHIBITIVE RIG TRIANGLES IMPOSE SEPARATE PORT AND STARBOARD SHEETS FOR OVERLAPPING SAILS

1. Mainsails and self-tacking headsails for conventionally rigged boats have always been non-overlapping sails controlled by a single sheet.

2. In contrast, Overlapping sails could tack or jibe only if controlled by separate, alternately tensioned port and starboard sheets, this being the opposite of "self-tacking." Genoa headsails exemplify such sails.

3. Sail designers never imagined that the back end, or "leech" of a self-tacking sail could overlap intervening companion rig elements yet still tack and jibe safely and reliably.

4. Notwithstanding, Applicant's System introduces overlapping, self-boomed, self-tacking semi-elliptical mainsails and headsails compatible with any sailboat rig geometry. Such a result is new and unexpected.

5. Nor could designers have imagined that semi-rigid battens could support the roach of a semi-elliptical sail while resisting inward forces imposed by a single-line reef system. Indeed, designers have stated systematically that only a rigid external spar could provide such results (see Amendment A, p.22).

GEOMETRIC PROOF THAT THE INVENTION IS NOT OBVIOUS

1. Superimposing the upper extremities of a right-angle triangle with an ellipse whose **half-height** equals the **full height** of the right-angle triangle necessarily results in an **external ellipse** that surrounds an **interior triangle** (see Amendment A, Figures 7,8, and 9).

2. Upright, this geometry replicates a mast-attached, overlapping semi-elliptical mainsail (see Amendment A, Figure 9).

3. Inclined to the angle of a forestay, the geometry replicates a forestay-attached, overlapping semi-elliptical headsail (see Amendment A, Figures 7 and 8). Designers never appreciated the importance of this geometry. **Applicant discovered a reliable relationship between an elliptical leech curve and the ability of a self-tacking, fully battened sails to cross intervening rig elements**. This discovery enabled Applicant's predetermined
maximum roach parameters

4. Applicant's use of the above geometry or any other well-known terms or concepts is for purposes of describing or setting in place the infrastructure of his System,. Such usage should in no way detract from patentability. In a parallel usage, the inventors of boom-contained sail furling mechanisms, as in Marechal or Moessnang, use the term, "boom" in describing the infrastructure of their inventions. Such usage in no way prevented the issuance of a patent in either case.

APPLICANT'S SYSTEM REPRESENTS A MAJOR ADVANCE IN A CROWDED CLASSIFICATION IN FAVORABLE MARKET CONDITIONS

Marechal and Moessnang exemplify rigid spar patents issued for minor changes to known devices in a crowded classification. In addition, each issued in a market climate in which the claimed rigid spar device sought to revive interest in a device that had fallen into disuse: in this case, rudimentary postwar

boom-furling devices. Both of the foregoing factors may have influenced patent issuance.

In the above context of patent issuance, Applicant's System should be considered more patent-worthy than any of the "referenced patents":

1. The System represents a major advance in the art of sail power;
2. The System would revive interest in economic, efficient hoisted sails, which have fallen into disuse; and
3. The present market climate favors a revival of hoisted sails if the convenience and safety issues can be resolved. (see Amendment A, pp. 26-27 and . 40-42).

Applicant respectfully submits that the foregoing establishes that his System is unobvious and patentable.

RESPONSES TO SPECIFIC OBJECTIONS OF THE FIRST OFFICE ACTION

Certain patents or specific subjects are treated in more than one Objection of the First Office Action. Applicant will respond to each such objection with maximum possible specificity **to assure response** to all aspects of each objection, **even at the risk of apparent repetition** of certain points.

The following Responses to specific Objections address respectively the formal and substantive objections of the First Office Action dated September 9, 2002 and mailed September 13, 2002. Restatement of each Objection of the First Office Action is followed by a corresponding Response accompanied, where appropriate, by reference to more comprehensive information found in the Specification and Drawings of Amendment A.

1. **Restatement of Objection**: "Claims 1,2,4-6 and 13-20 are withdrawn from further consideration Pursuant to 37 CFR 1.142(b) as being drawn to a nonelected invention, there being no allowable generic or linking claim. Election was made with traverse in Paper No. 5."

Response: Amendment A excludes the above-referenced Claims and substitutes Claims 21-36 for elected Claims 2 and 7-12 of the original Application.

2. **Restatement of Objection**: "The Claims and Specifications are objected to because of the following informalities: in the Claims and Specification, "the said" is redundant in nature. Appropriate correction is required."

Response: Amendment A has been drawn to comply with the foregoing instruction.

3. **Restatement of Objection**: The abstract of the disclosure is objected to because it contains legal phraseology. Correction is required. See MPEP Sec. 608.02 (b)."

Response: In conformity with the foregoing Objection and MPEP Sec. 608.02 (b) The Abstract of Amendment A has been drawn as follows:

A comprehensive, universally compatible System of hoisted semi-elliptical mainsails and self-tacking headsails reconciling optimum sail performance with optimum safety and convenience. Non-overlapping Maxjib (28), overlapping Maxjib (26), and Maxmain (30) are self-boomed, self-tacking hoisted sails that incorporate both predetermined maximum roach parameters and embodiment-specific semi-rigid batten layouts. External spar Maxmain (32), a boomed sail, extends System benefits, including predetermined maximum roach overlap perimeters, to boomed mainsail configurations. External batten reduction and integral batten substitution configurations as well as headboard-end plate combinations produce synergism of result. Usable in various combinations, System sail embodiments enable self-boomed, overlapping mainsails and self-

boomed, overlapping self-tacking headsails, thus making available optimized, cost-effective sail power for both recreational and commercial users of wind-powered vehicles.

4. **Restatement of Objection**: "The Drawings are objected to under 37 CFR 1.83(a). The Drawings must show every feature of the invention specified in the Claims. Therefore, the batten substitute means must be shown or the feature(s) canceled from the claim(s). No new matter should be entered. A proposed drawing correction or corrected Drawings are required in order to reply to the Office Action to avoid abandonment of the application. The Objection to the Drawings will not be held in abeyance."

Response: The substitute Drawings and Claims of Amendment A, specifically **Figures 11, 11a, and 11b and claims 28-33,** illustrate the specific properties of batten reduction combinations and batten substitutes in compliance with the foregoing Objection 4. No new matter has been entered. The depicted and claimed batten reduction combinations and batten substitutes can be realized using existing sail making materials and methods. While system design accommodates "evolving technology," batten substitute technology can be reduced to practice using presently existing materials and methods (see Amendment A, pp. 53-58).

5. **Restatement of Objection**: "Claims 2 and 7-12 are rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the Specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention.

Applicant's claimed "means for booming" and "means for reefing and controlling" has not been disclosed so as permit one of ordinary skill in the art to make and/or use the invention.

Such means as disclosed includes a "batten substitute", and the Specification states that "evolving technology will likely make possible batten substitute means...." Such is indication that the present invention has not been reduced to practice, and that one of ordinary skill in the art need "invent" such a batten substitute to make and/ or use the present invention."

Response: Means for booming and reefing a System sail consist of task-specific batten layouts in combination with single-line reef configurations. Amendment A, at pages 72-91 explains in detail **how to make** each System embodiment, and at pages 99-107 explains in detail **how to install** and **how to use** each System embodiment.

In all cases, the disclosures of Amendment A have been drawn as to allow one ordinarily skilled in the pertinent art to make and use the invention.

Summary responses to the individual questions raised by Objection "5" follow immediately below.

A. Unique upward or downward-oriented diagonal semi-rigid batten layouts, are "means for booming", which provide diverse new and unexpected results. (see Amendment A, pp. 42-46; Figures 1, 2, 3, 4, 4a, 5, and 5a, and Claims 34-36),

B. "Means for reefing" consisting of cordage, fairleads, and pulleys are described and depicted in detail, as are "means for controlling" including embodiment-specific integral booming and vanging effected by semi-rigid batten layouts." Means for controlling" are further disclosed as

regards self-tacking sheet configurations (See Amendment A, p.46 and Figures 4 and 5).

C. Applicant's System employs novel semi-rigid batten layouts as well as known self-tacking sheet configurations or sailcloth. The fact that System infrastructure includes such known component parts in no way derogates form the System's various new and unexpected results. (see Amendment A, p.59, Figures 1, 2, 4, and 5 and Claims 34-36).

D. Amendment A discloses **"batten substitutes"** in detail at pages 53-60, in Figures 11, 11a, and 11b; and in Claims 28-33. Those disclosures describe both external batten reduction configurations and integral batten substitute configurations as to allow one skilled in the pertinent art to make and use both configurations with presently existing methods and materials.

E. Methods and materials for producing batten reduction and batten substitute configurations already exist. Applicant has reduced to practice and extensively tested prototype mainsails that simulate batten reduction combinations and batten substitutes, and that confirm their technical feasibility.

F. In addition, Applicant's market research confirms that batten reduction combinations and batten substitutes are commercially viable using existing methods and materials. Development to production stage will require a commercial partner having the means and equipment to prototype batten reduction combinations and batten substitutes to production level.

G. Amendment A fully discloses fabrication of sails using batten reduction combinations and batten substitute configurations, including relative fiber densities and variable density zone intervals, as to allow one ordinarily skilled in the pertinent art to make and use sails employing batten reduction or batten substitute configurations (see Amendment A, pp. 55-60).

6. **Restatement of Objection**: "Claims 2 and 7-12 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

In claim 2, "such headsail" lacks antecedent basis in the claim(s). Claims 7 and 12 lack a period, and their completeness is thereby in question. In claim 7, "said headstay" lacks antecedent basis in the claim(s)."

Response: Substitute Claims 21-35 have been drawn in conformity to the referenced requirements of 35 U.S.C. 112 as to specifically point out and distinctly claim that the subject matter Applicant regards as the invention. Claims 21-35 have been drawn to comply with the objections of form contained in Objection 6 of the First Office Action.

7. **Restatement of Objection**: "The following is a quotation of 35 U.S.C. 103 (a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if

the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made. Patentability shall not be negativated by the manner in which the invention was made."

Response: Applicant respectfully submits that the foregoing preliminary comments and summary responses to the First Office Action establish that **in no way** could the prior art have made the subject matter of Applicant's Amendment A obvious to a person having ordinary skill in the art to which said subject matter pertains. The subject matter of Applicant's System is both distinct from and diametrically opposed to the prior art. Applicant's System is so unobvious, that even at the present date a person having ordinary skill in the pertinent art would consider the problems the System resolves as insolvable.

NEW AND UNEXPECTED RESULTS PRODUCED BY THE INVENTION

A more comprehensive treatment of new and unexpected System results appears in Amendment A at pages 59-64. A restatement of some of the System's new and unexpected results appears immediately below:

A. Universally compatible, predetermined maximum roach parameters.

B. Hoisted, overlapping mainsails and self-tacking headsails that optimize sail area and efficiency for any sailboat without modification to boat or rig.

C. Self-booming and vanging, cockpit-controlled deployment, and single-line reefing and recovery for any hoisted mainsail or self-tacking headsail without resort to a rigid external spar.

D. Comprehensive System cockpit control and self-boomed configurations compatible with conventional sail profiles as well as semi-elliptical sail profiles (see Amendment A, pp. 46, 60, 97).

E. Overlapping, self-tacking **System sails use permanent backstays to advantage,** whereas permanent backstays had always posed a major, absolute restriction on sail size and shape (see Amendment A, p. 16).

F. As an overlapping System sail contacts an intervening rig element, the sail automatically remains aback momentarily, then crosses the rig element sequentially from initial rig contact point **80** upwards. As the boat approaches the axis of the wind, at the most advantageous moment, the head of the sail automatically crosses the intervening companion rig element in a release of stored energy, accelerating a boat through the axis of the wind onto its new course (see Amendment A, page 46, 97).

G. Entirely new sail types for new markets: overlapping, System semi-elliptical mainsails and self-tacking headsails meet an unsatisfied demand for easily controlled sails with adequate power for light air conditions.

H. Optimum sail interface as opposed to the turbulent interference generated by triangular sails.

I. Dynamic sail response to changing wind and sea conditions by means of diagonal semi-rigid batten layouts that replace rigid external spars.

J. Batten reduction combinations and batten substitute configurations for both boomed and self-boomed sails that not only optimize performance and convenience, but also reduce costs for boat builder and buyer alike.

K. Headboard-end end plate combinations that simultaneously benefit safety and performance producing synergism and a new aftermarket product (See Amendment A, pp. 62, 74, 94; Figures 9, 9a, and 9b; and Claims 24-26).

L. Unforeseen use of a Van Breems Dutchman™ deployment device to evenly support the foot of <u>a reefed, self-boomed sail</u> (see Amendment A, pp. 60-61, 103), thus enabling single line reefing for self-boomed sails.

M. Self-reinforcing reef triangulation that allows dispensing with a rigid, external spar (see Amendment A, pp. 93 and 98.

N. Unexpected applications of fiber-oriented sail making methods to enable smaller, lighter battens or to eliminate battens altogether (see Amendment A, pp. 53-60; Figures 11, 11a, and 11b; and claims 29, 31, and 33).

8. **<u>Restatement of Objection</u>**: Claims 2 and 7-12 are rejected under 35 U.S.C. 103(a) as being unpatentable over **Marechal**. Marechal teaches a vertically deployed sail attached to a mast. Battens are provided for sail control, and such is shaped as claimed. Marechal does not disclose provision of a forestay and forestay attached sail, however, such is considered to have

been notoriously old and well known in the art, and provision of same would have been obvious to one of ordinary skill in the art at the time of the invention, providing no unexpected results.

An end plate **33** is provided. The material of construction and/or color is considered to have been an obvious design consideration. The relative size of the sail is considered to have been an obvious design consideration as well."

In addition to the above specific reference to **Marechal**, the First Office Action cites the patent issued to **Moessnang**, no. 5,632, 215, 5/1997, and the patent issued to **Van Breems**, no. 4,688,506, 8/1987.

Response: Responding in the order of the individual Objections set forth in 8, above:

A. Applicant does not claim to have invented a forestay attached sail, but rather to have invented self-boomed semi-elliptical sail embodiments compatible with the rig geometry of any sailboat. Each such embodiment can overlap companion rig elements yet still provide optimum sail area and efficiency.

B. Some System sail embodiments are forestay-attached; some are mast-attached. In either case, use of terms such as forestay or mast-attached is for purposes of describing the System's infrastructure. Such usage in no way obviates the new and unexpected results produced by each System sail embodiment. Accordingly, the obviousness of a forestay-attached sail is not pertinent to Applicant's claims.

C. Neither forestay-attached nor mast-attached universally compatible, overlapping self-tacking sails are in any way obvious. Amendment A discloses specifically both the novelty and unexpected results of such sails and also discloses their construction and use as to allow one skilled in the art to make and use the invention. Applicant submits that the invention is unobvious and therefore patentable over the prior art (See Amendment A, pp.20-21, 34-42).

D. Marechal makes no allusion to a forestay-attached sail. Due to its weight and encumbrance, a Marechal-type boom would **not be functional** in combination with a forestay-attached sail. Furthermore, a Marechal-type boom <u>**cannot** accommodate diagonal battens</u>. Accordingly, the subject matter of Marechal does not pertain to that of Applicant's forestay-attached System embodiments.
The fact that a forestay-attached sail is a well-known generic element of a sailboat in no way diminishes the independent, unexpected results of System embodiments that are forestay-attached.

E. Certainly, both boomed and unboomed forestay--attached and mast-attached sails are well known, and Applicant makes no claim to inventing them. Such configurations simply constitute generic infrastructure elements to which a wide diversity of elements may attach. Such elements range from sail slides to clew rings to Applicant's System sail embodiments.

F. As applicable to such generic infrastructure, Applicant's System introduces unique self-booming semi-rigid batten layouts, which produce the new and unexpected results of eliminating rigid external boom and

wishbone spars and enabling single-line reefing in the absence of such rigid spars(see Amendment A, p. 46; Claims 21-23 and Claims 34-36).

G. System batten layouts are claimed in combination with unique predetermined maximum roach parameters, and the combination produces further new and unexpected results concerning optimum sail area and efficiency for any sailboat without modification to boat or rig.

H. The significance of patent issuance in Marechal, Moessnang, and other rigid boom patents as well as their strictly insular subject matter is reviewed more comprehensively at pages 34-42 of Amendment A.

I. **Applicant's sail System eliminates the very boom that constitutes the subject matter of Marechal** and other rigid spar patents. In addition, those patents neither teach nor infer anything about the back end of a sail. Accordingly, those patents <u>in no way pertain to any element whatever of Applicant's System</u>, including self-booming batten configurations, specific leech curve parameters, and universal rig compatibility.

In light of the foregoing, Applicant respectfully submits that his System is entirely distinct from the subject matter of such external spar patents and is patentable over them by virtue of the System's novelty and unexpected results.

<u>HERETOFORE UNIMAGINABLE SYSTEM RESULTS</u>:

A. A self-tacking sail that is **self-boomed** <u>by a semi-rigid batten layout, thus eliminating the need for a rigid external spar such as the Bierig half-wishbone</u> (See <u>Bierig</u>, p.2, line 21).

B. A **semi-rigid batten layout** capable of maintaining the foot of a mainsail or self-tacking headsail sail in horizontal extension against the force of the wind (See Bierig, p.1, line 51); and against inward reef line forces (See Bierig, p. 2, line 20); and **that eliminates a rigid spar altogether.**

C. Overlapping self-boomed mainsails and self-tacking headsails that tack and jibe reliably and safely without unusual sail wear across a permanent backstay on any sailboat in all conditions.

D. Self-boomed mainsails and self-tacking headsails that combine full cockpit control of all deployment, reefing, recovery and stowage functions while providing optimum motive power through a wind speed range of five to thirty-five knots and above.

UNEXPECTED RESULTS PRODUCED BY REALIZING HERETOFORE UNIMAGINABLE OBJECTIVES.

Further unexpected System results include:

A. Maximum sail area and efficiency without resort to long-footed genoas, free flying sails, or costly tall rig transformations (See Amendment A, pp.10-13, 47-52; 64, 99,).

B. Full cockpit control of optimum sail power for all sailing conditions from **only two hoisted sails**. The importance and unforeseeability of **eliminating on-deck sail handling for hoisted sails** cannot be overemphasized. Heretofore, it has been accepted that changing or reefing hoisted headsails inevitably imposed on-deck sail handling (see Amendment A, p.11).

C. Predetermined maximum roach parameters that enable unique, embodiment-specific batten layouts that employ task-specific active and passive energy cycles (see Amendment A, p. 93).

D. **Elimination of rigid boom and wishbone spars:** not with a loss of capability, but rather **with gains in convenience and safety** that only increase as conditions deteriorate (see Amendment A, pp. 63-65).

E. Hoisted semi-elliptical working sails that produce **optimum sail power for all sailing conditions** with **convenience and safety equal or superior to counterpart furling configurations:** Triangular furling sail configurations achieved market dominance because they eliminated on-deck sail handling.

F. Hoisted System sail configurations **eliminate on-deck sail handling** entirely and **have no mechanism to jam in difficult conditions.** In addition, hoisted System sails reduce sail cost, reduce weight aloft and, above all, and produce low-effort, optimum performance in all conditions for shorthanded crews.

G. Overlapping, self-tacking semi-elliptical sails provide automatic acceleration through tacks and jibes, satisfying long standing market demands that conventional triangular configurations **cannot**: easily controlled, truly versatile sails.

H. Applicant's System reduces boat construction costs unexpectedly by providing sail area equivalent to tall rig configurations, but without their cost and encumbrance and without any change to boat or rig (see Amendment A, pp. 47-50). Unexpectedly, the System introduces a **new**

economics for sailboat owners and the sailboat industry (See Amendment A, p. 47).

Applicant submits that the abovementioned System results have heretofore been ignored entirely; considered unfeasible; impossibly remote; or dismissed as far-fetched. These entirely new and unexpected results establish that Applicant's System is unobvious and patentable.

THE REFERENCED PATENTS AND OTHER RIGID SPAR PATENTS CONFIRM THAT APPLICANT'S SYSTEM IS UNOBVIOUS

Amendment A claims that the System produces unexpected results when connected to a wind-powered vehicle. Applicant submits that use of the term, "wind-powered vehicle" or "wind-powered vessel" should not affect patentability of the System. The patent to **Van Breems**, no. 4,688,506, 9/1985, for example, claimed a sail system for use with a sailboat having "a mast, a boom…a flexible sail".

A. Van Breems' reference to a mast, boom, and flexible sail simply described the means by which the Van Breems invention connected to a companion sailboat, being part of the "infrastructure" of the claimed invention. Notwithstanding the use of such well-known terms, a patent issued, thus confirming that the prior art had not anticipated the claimed invention.

B. Van Breems is exemplary of patents granted for a small variation on a well-known device connected to a sailboat and which recite well-known infrastructure such as a forestay attached sail or a mast (see Amendment A, pp. 59-61).

C. Other patents referencing well-known elements such as a mast without claiming those elements include Hoyt, no. 5,463,969, 6/1994 and Moessnang, no. 5,632,215, each of which pertained to rigid boom inventions.

D. Applicant submits that the System's design is novel, and that it produces new and unobvious results, as opposed to well-known infrastructure elements such as a companion sailboat or elements of a sailboat.

E. Just as Van Breems was not claiming a mast, a boom, or a sail; Applicant does not claim a mast-attached mainsail; a forestay-attached headsail; sail making materials; colors; or other well-known infrastructure elements of wind-powered vehicles. Rather, Applicant's claims are for entirely new sail embodiments that produce new and unexpected results.

F. The fact that Applicant's System sail embodiments may be classified generically as mast-attached mainsails or forestay-attached headsails in no way obviates patentability. If such were the case, the patent classification system, itself, would prohibit prospective inventions entirely. Clearly, such a result is not the object of patent legislation and regulations.

G. Neither Marechal, Moessnang, nor other rigid spar patents disclose or infer anything whatever pertinent to a universally compatible sail System that dispenses with rigid booms in favor of a hoisted semi-elliptical sail conforming to predetermined maximum roach parameters and that is self-boomed by unique semi-rigid batten layouts.

H. The subject matter of **Marechal** is entirely distinct from that of the invention. Moreover, the text and Drawings of Marechal go even farther; **to specifically exclude any possibility** that Marechal taught or inferred anything pertinent to Applicant's System (See Amendment A at pp. 34-40 for a detailed analysis of referenced patents including Marechal and Moessnang).

I. Marechal addressed neither sail profile nor rig compatibility. Marechal pertained only to how the **leading edge of a mainsail** might roll into the claimed furling boom. Marechal clearly taught that the following were **not pertinent to its subject matter:**

   i. The body or leech of a sail.
   ii. The trailing edge, or leech of a sail.
   iii. A sailboat rig, notably a backstay or other rigging wire.
   iv. A self-boomed sail that **dispenses with** the very boom disclosed by Marechal and its prior art references.
   v. A self-boomed sail that combines semi-elliptical shape, one line reefing, automatic tacking acceleration, and automatic flaked stowage (See Amendment A, pages 33-34, 107-108); or
   vi. a sail integrating diagonal battens, which are absolutely incompatible with the Marechal boom.

B. **Marechal,** along with its prior art references **discloses a boom** that rolls a sail into its body. That patent has nothing whatever to do with a hoisted, semi-elliptical sail that produces its unexpected results without resort to an external rigid boom. Nor does Marechal pertain in any way to any of the following aspects of Applicant's System

i. Predetermined maximum roach parameters enabling self-tacking overlapping headsails and mainsails.

ii. Batten reduction combinations or batten substitutes.

iii. headboard-end plate combinations.

iv. Function-specific batten orientation: The horizontal battens described and depicted in Marechal were only **optional.** Marechal did not claim that battens were requisite to the functioning of the claimed invention. Indeed, it could not have functioned at all with diagonal battens (See Amendment A, p.34).

v. Accordingly, Marechal did not teach or infer diagonal semi-rigid batten layouts. **Nowhere does Marechal disclose, explicitly or implicitly, function-specific batten orientation.**

vi. **The aft end or "roach" of a sail.** Nowhere does Marechal assign a specific identifying number to a sail, whereas it does assign a specific number to the luff of the sail shown in the patent. Clearly, **only the luff area of a sail is relevant** to the Marechal invention.

vii. Nowhere does Marechal describe the leech of a sail, **whereas** it specifically describes and numbers the luff of a sail. In fact, **omission** of the back end of Marechal's sail would not have affected its claims in any way. Marechal was concerned uniquely with the relationship between its boom mechanism and the <u>front end</u> or luff of a mainsail (See Amendment A, p. 34).

viii. **The relationship between the aft end of a sail and the rig elements of a sailboat.** Marechal does not identify depict, or disclose a sailboat rig at all. Clearly, the subject matter of the patent could not have pertained to the

relationship between the back end of a mainsail and a sailboat's backstay, or to the relationship between the back end of a headsail and a sailboat's mast or shrouds (see Amendment A, pp. 34-36).

ix. **A headsail:** Marechal simply discloses a means of rolling a **mainsail** into a boom, nothing more. Forestay-attached headsails were, indeed, well-known at the date of the Marechal patent, yet Marechal avoided addressing such sails. Clearly the Marechal device had nothing to do with headsails of any nature.

x. Overlapping self-tacking headsails were inconceivable at the date of Marechal and still are. No aspect of the Marechal furling boom claim can in any way pertain to the Applicant's invention, which **eliminates** entirely rigid external booms such as the one claimed in Marechal.

C. Material of construction and/or color of any manufactured object may be considered an obvious design consideration. Conversely, a function-specific device that combines known elements to produce new and unexpected results is unobvious.

E. Headboard-end plate combination **74** exemplifies just such an unobvious device. A conventional headboard consists of two flat aluminum plates riveted on either side of the head of a sail with a hole for attaching a halyard. **No aerodynamic or safety properties are inherent or foreseeable in a conventional headboard. Nor is synergism of result foreseeable in the use of a conventional headboard.**

F. Headboard-end plate combination **74** combines flat headboard plates with "wings" or end plates, forming right angles that are optimum for

reflecting radar waves. The combination thus <u>produces unexpected, mulltifunciton safety and aerodynamic results and synergism</u> **at the top of a sail**.

G. As concerns sailboats, end plate effect has always been associated with the **bottom** of a sail. For this reason, “”deck sweeping hedsails and even wide mainsail booms have been employed to provide end plate effect, or to reduce turbulence below the foot of a sail. No similar attention has been directed to the **top** of a sail, which is the most powerful part of a sail.

The combination’s aerodynamic results are minimized turbulence and increased lift at the all-important level of a sail’s head. In addition, a synergism with other sails is achieved. Since the headboard-end plate combination reduces turbulence, it enables optimum interface with other sails. None of the foregoing are foreseeable in the context of a conventional headboard.

End-plate effect for sails, on the other hand, has <u>always concerned the **foot** of a sail, **not its head**</u>. The foot of a “deck sweeping” headsail is still considered by designers to have a beneficial end plate effect (see Amendment A, p.62, item 9).

“...drag is minimized in a headsail [by] extend[ing] its foot down to the deck...Called a deck sweeper....This solution is more common for the racer than the cruiser because [it] reduces visibility to leeward;” (Whidden, <u>The Art and Science of Sails</u>, St. Martin’s Press, 1990).

Thus, a novel System embodiment achieves a further unexpected result by providing aerodynamic end plate effect without reducing visibility to leeward.

<u>Having achieved diverse unexpected results</u> and synergism without regard to color, the headboard-end plate combination's <u>color or material of construction neither renders its new and unexpected results obvious nor detract from its patentability</u>.

For example, supposing cast iron and aluminum to have equal radar-reflective properties, it would be logical and obvious to use the lighter, rust-free material for a headboard-end plate combination. Such a choice would be foreseeable, but would in no way impact whether the combination eventually fabricated from aluminum was unobvious

Applicant does not claim to have invented aluminum, carbon fiber, an integral radar reflective scrim, particular colors, or reasons for using them for a headboard-end plate combination. Contrarily, Claims 24-26 of Amendment A, discloses a new <u>combination of a flat headboard</u> with <u>port and starboard right angle wings</u>, resulting in **unexpected performance and safety results as well as intersail synergism**. Applicant submits that the novel, multifunction combination produces diverse unexpected results and synergism justifying patentability without regard to color or material of construction.

Finally, present market climate is favorable to aerodynamic innovations. A headboard-end plate combination is applicable to any sail, thus comprising a new product for broad market application. Just as a favorable market climate attached to rigid spar patents, a favorable market is present for a headboard-end plate combination, either as an aftermarket item or as a component part of System sail embodiments.

D. Amendment A alludes to "relative size" and other terms of design consideration merely to establish a comparative frame of reference. or to

establish the infrastructure of the System's novel, unobvious properties and elements. (see preceding Response pages 8 and 22-23) .

F. Applicant's system achieves its unexpected results by virtue of unique overlapping, self-tacking, semi-elliptical sail embodiments that, unexpectedly, **extend** maximum possible sail area and efficiency by enabling System sails to overlap intervening companion rig elements while unexpectedly safely and reliably tacking and jibing across them.

H. Applicant's maximum roach parameters and self-booming batten layouts have been uniformly ignored or dismissed as remote or unfeasible. As such, Applicant submits that they are unobvious and patentable.

I. The System's **widely diversified new and unexpected results** range from enhanced tacking and jibing, to reduced crew fatigue, to unprecedented economics for the sailboat owners, buyers, and the sailboat industry.

J. Relative sail size is a unique and unexpected advantage <u>if the increased area takes the most efficient and most easily used form</u>. Such is the case with System sails, in direct contrast to tall rig configurations. System sails place a maximum of the most efficient area as high as possible while providing self-tacking convenience.

K. Applicant's predetermined maximum roach parameters **enable a transition** from the least efficient, triangular sail form to the most efficient, semi-elliptical sail form; a transition **which heretofore has been considered absolutely impossible for mainsails and self-tacking headsails used on conventionally rigged sailboats**.

L. Overlapping mainsails and self-tacking headsails have always been considered incompatible with conventional sailboat rig geometry. A boat's

rig elements permitted <u>only</u> non-overlapping, self-tacking sails. Applicant's unique predetermined maximum roach parameters and semi-rigid batten layouts have finally made feasible what was formerly inconceivable.

9. **Restatement of Objection:** "The prior art made of record and not relied on is considered pertinent to the applicant's disclosure. Moessnang et al. teaches a batten reinforced semi-elliptical sail."

Response: First, Moessnang and other rigid spar patents allude only to horizontal battens, and even then, such **battens are not a requisite part of the claimed invention.** Second, Moessnang and similar boom furling devices <u>cannot accommodate diagonal battens</u>. Consequently, <u>**there is no reason to suppose**</u> that such patents anticipated or otherwise made obvious the System's diagonal batten layouts, which cannot be furled by a furling boom, and which eliminate the very subject matter of Moessnang and other rigid boom patents.

Moessnang and other rigid boom patents would hardly have foreseen their own demise. Stated otherwise, those patents were hardly drawn to be "self-destructing", and their prior art did not anticipate the elimination of external rigid booms by diagonal semi-rigid batten layouts. Rather, the referenced prior art specifically limits itself to subject matter that in no way pertains to Applicant's disclosures and claims.

THE LANGUAGE AND DRAWINGS OF MARECHAL AND MOESSNANG DO NOT PERTAIN TO ELLIPTICAL LEECH CURVE OR RIG OVERLAP

A. Marechal, Moessnang, and similar rigid spar patents <u>specifically exclude any possibility that their subject matter pertains in any way to Applicant's</u>

System. Such patents pertain exclusively to the mechanical features of diverse rigid spar devices, and the results they produce without regard to leech curve or rig overlap, and without regard to **any** specific part of a sailboat rig or to any part of a sail except for a sail's luff tape. (See Amendment A, pp. 35-42, where each such patent is closely examined).

B. In direct opposition, Applicant's System is drawn relative to a conventional sailboat rig, and no System sail embodiment uses a luff tape. **Even in the most general context** of well-known rig and sail making components there is no commonality between the subject matter of the referenced patents and that of Applicant's System.

C. Each of the abovementioned rigid spar patents **could have** described or inferred leech curve and rig or rig overlap specifics. None did so because those subjects were irrelevant to the subject matter of each such referenced patent.

D. Simply stated, rigid spar patents deal with how a rigid spar can be used to control and/or store a sail. **Applicant's System pertains to a distinctly different subject matter, and, indeed, produces its new and unexpected results in the absence of a rigid boom or wishbone spar.**

E. System sail embodiments not only reconcile the most efficient sail profile with conventional sailboat rig geometry, but also reconcile optimum sail performance with optimum safety and convenience. Those new and unexpected results derive without resort to a rigid boom or wishbone spar; and without resort to furling or otherwise rolling a sail for reefing or stowage.

<u>RIGID SPAR PATENTS DO NOT PERTAIN TO A SAILBOAT'S RIG OR TO THE AFT END OF A SAIL</u>

A. A sailboat's rig and every part of a sail except for its luff are **entirely dispensable** to referenced patents Marechal, Moessnang, and Van Breems. Those patents describe and depict a sail and a sailboat rig only in an arbitrary, random manner if at all.

B. Reference to a patent for a <u>non-furling</u> boom patent broadens the view of rigid boom patents and further proves that the entire prior art of rigid spars patents in no way pertains to the subject matter of Applicant's System.

C. <u>US Patent 5,463,969 to Hoyt (1995</u>) illustrates a patent granted for a minor variation on known **non-furling** rigid boom spars. Hoyt claimed a curved, freestanding boom mounted in a deck socket. The boom connects to a generic sail but does not serve to furl or otherwise stow the sail. In fact, **a sail's profile is entirely irrelevant to the subject matter of Hoyt**. There is no reason to suppose that Hoyt, or its prior art anticipates Applicant's invention or otherwise renders it obvious.

D. A detailed examination of Hoyt is useful in showing specifically that rigid boom patents are not pertinent to leech curve specifics, rig overlap, or other aspects of Applicant's invention.

E. Operation of the Hoyt boom device and other non-furling boom devices, patented or non-patented, <u>requires only that a sail have a head, tack, and clew.</u> The prior art pertinent to such patents ignores a sail's leech profile and roach size entirely; ignores a sail's leech; and above all, ignores the

presence or absence of task-specific diagonal batten layouts, rig overlap, or batten reduction and batten substitute technology.

F. In sum, sail profile, predetermined maximum roach parameters, and the other unique elements or combinations of Applicant's System, are irrelevant to Hoyt and other non-furling boom patents and their prior art.

G. **No sail whatever appears in Hoyt's** text or its title-page-drawing. Presumably the Abstract and title-page-drawing would disclose a sail if a sail were germane to the subject matter of the invention.

H. In fact, the only sail depicted in Hoyt appears in its Fig. 1, which shows a generic sail with <u>partial battens</u> set from a freestanding, rotating mast with no supporting rigging. In no way has Hoyt anticipated any of the novel properties of Applicant's System, notably its unique diagonal full-length self-booming batten layouts. It suffices to note that Hoyt was not drawn to be self-destructing. Rather, the premise of boom patents is that a boom is required to perform the functions of a boom. **Applicant's System belies this circular and ultimately false assumption**.

I. Since Hoyt's subject matter was unrelated to rigging wires or sail profile, it could not have addressed neither rig overlap; nor overlapping diagonal batten layouts, nor predetermined maximum roach parameters, nor universally compatible self-boomed, self-tacking semi-elliptical sails. Hoyt neither discloses nor infers anything pertinent to those subject.

J. By means of a rigid boom, Hoyt sought to assure constant foot tension and to eliminate topping lifts and "**some** of the other problems associated with conventionally rigged sailboats, including clearance problems due to the swinging of the boom across the cockpit." (see Hoyt, p.1, lines 44-60).

Applicant's System resolves **all** such problems by **eliminating** booms altogether (see Amendment A, p. 42). **Such a solution is the very last thing Hoyt or other rigid boom patents could have foreseen.**

K. A Hoyt boom is an extremely expensive modification; one having a high initial purchase price, and one that imposes extensive, costly structural modification to a boat's deck at installation. High initial cost and deck encumbrance have limited the Hoyt boom's market penetration to approximately 1000 units since the date of the 1995 patent. Even those sales may be largely attributable to the fact that Mr. Hoyt is one of the sailboat industry's most able marketing personalities.

L. Once installed, the Hoyt boom does nothing to enable maximum sail area or to eliminate the many problems it either imposes or fails to solve. The following recent email inquiry and response found at "sailnet.com" point up some of those problems, <u>most importantly, the following email exchange clearly shows that Hoyt booms do not even allow use of a 100% triangular sail, let alone an overlapping semi-elliptical sail</u>. Such a limitation illustrates that even the most recent self-tacking configurations **presume the indispensability** of a rigid spar and in no way conceive of an overlapping, self-boomed, self-tacking sail.

"**Author:** bayme

Date: Jan. 24, 2003 3:24 PM

has anyone sailed with a Hoyt jib boom and can they add some feedback.

Date: Jan. 24 2003 7:14 PM

Author: Jeff_H *(burr.halpern@annapolis.net)* I found the one that I sailed on to be a real pain in the butt. Unlike a normal jib boom the Hoyt boom blocks the center of the foredeck at a fixed height making it difficult to move around the deck and handle dock lines and anchoring gear. It also results in sail shaping that is at best only right at one narrow point of sail, just cracked off of a beat on the boat that I was sailing. Reaching and running the sail shape was awful. Given that you are already giving up performance by **going down to a 90% jib (or less)** with a high clew and tack, sail shape becomes even more critical. Jeff"

The author of the above response observes that the Hoyt boom limits sail size to a 90% jib, thus further confirming that the Hoyt boom and similar booms in no way anticipated an overlapping sail such as the one shown in **Figure 6** of Amendment A. His message is clear: self-tacking headsail function is a highly desirable result, but rigid jib booms impose undersized sail area, inadequately control sail shape; and encumber a boat's foredeck.

M. Applicant submits that a self-boomed System sail provides comprehensive, dynamic sail control features where rigid booms cannot. In addition, System sails provide overlapping, self-boomed, self-tacking semi-elliptical sail results **with no modification to boat or rig**.

N. Without the slightest regard to sail profile or rig overlap, a rigid **boom**, whether patented or not, is **nothing more than a spar** to connect a sail to.

O. A **self-boomed sail** that combines universal compatibility with optimum sail area and efficiency **is another subject entirely**.

P. Rigid booms interfere with the ability of a sail to respond dynamically to changing conditions.

Q. Applicant's System enables automatic, dynamic sail by means of unique semi-rigid batten layouts that **self-boom and self-vang** System sail embodiments. The unexpected result is comprehensive, automatic, and dynamic sail shape control, including control of foot and leech tension.

R. Of equal importance, Applicant's embodiment-specific diagonal batten layouts enable cockpit-controlled single-line reefing in the absence of a rigid boom or wishbone spar. Each of the above results is new and unexpected.

S. Hoyt in no way teaches or infers even a single full-length diagonal batten. Neither Hoyt nor related prior art could have anticipated Applicant's embodiment-specific full-length diagonal batten layouts.

T. Nowhere do the abovementioned rigid spar patents make the slightest inference that **rigid spars could ever be eliminated by** task-specific semi-rigid **batten layouts.** In fact, Bierig states categorically that battens cannot provide adequate sail shape control, and that only a rigid spar is capable of doing so (Bierig, p.3, lines 17-18).

U. The subject matter of Marechal, Moessnang and other rigid spar patents is **insular**, being limited exclusively to a mechanism for furling a <u>mainsail</u> into the body of a rigid boom for the express purpose of stowing that mainsail in a rolled, or "furled" configuration.

V. The operation of Applicant's System and rigid boom furling devices are diametrically opposed, and their respective subject matter is unrelated.

W. The only part of a sail that pertains to the operation of a furling boom is its luff and luff tape. System sail embodiments, whether headsails or

mainsails do not require a luff tape. Thus, A sail's luff and luff tape specifics are entirely irrelevant to Applicant's System. Rather, System headsail embodiments clip or "hank" on to companion forestays. System mainsail embodiments typically connect to companion mast tracks with sail slides.

X. All System sail embodiments gravity-stow in a folded or **"flaked"** configuration without resort to any mechanism, **as opposed to** a rolled or **"furled"** configuration whose stowage depends on a furling mechanism.

  i. The respective objectives and results of furling boom patents are entirely distinct from those of Applicant's System. The former pertain to **furling the front end of a sail**, which inevitably is accompanied by the back end during the furling process.

  ii. In contrast, Applicant's System pertains to **universally reconciling an overlapping leech curve with intervening rig elements**. There is no relation between the two sets of objectives and results. Nor is there any reason to suppose that the prior art of furling or non-furling booms in any way pertains to or anticipates the subject matter of Applicant's invention (see Amendment A, pp. 32, 35-36, 40-42).

Applicant respectfully submits that none of the abovementioned rigid spar patents disclose or imply anything pertinent to the subject matter of Applicant's System.

MARECHAL, MOESSNANG, AND OTHER RIGID SPAR PATENTS DO NOT PERTAIN TO A SAIL'S ROACH

A. **Marechal** and **Moessnang both state explicitly** that positive roach is merely **an optional** sail element (see Amendment A, pp.35- 36).

B. As concerns battens, Marechal stated specifically at p. 4, line 56 that battens were **not** requisite to the operation of its boom furling device. Similarly, Moessnang, another rigid furling boom patent, was concerned not with the ability of battens to control sail shape but only in preventing battens from "piling up" on each other during the furling operation (see Moessnang, p. 8, line 44).

C. Like other rigid boom patents, Moessnang could hardly have anticipated even a single full-length diagonal batten because furling booms **cannot** accommodate diagonal battens. There is no reason to suppose that furling boom prior art would address or anticipate the impossible.

D. One System embodiment, external spar Maxjib **32,** does use horizontal battens and does connect to a conventional, rigid boom or, even to a furling boom. Notwithstanding its well-known infrastructure, that embodiment achieves its novelty and its new and unexpected results through embodiment-specific predetermined maximum roach parameters. Those results are not only functional, but also economic, allowing System sails to address the broadest possible markets. (see Amendment A, pp. 106-7 detailing the complementary marketing rationale applicable to external Spar Maxmain **32;** self-boomed Maxmain **30** and self-boomed Maxjibs **26** and **28**).

E. In addition, all System sails can incorporate batten reduction combinations; batten substitute configurations; and headboard-end plate combinations to produce further synergism and unexpected results (See Amendment A, pp. 53-38, Figure 9b, and Claims 24-26 and 28-33).

F. To summarize: Applicant's System embodies subject matter directly **opposite** to that of the abovementioned reference patents and to that of other rigid spar patents. None of those patents either teaches or anticipates anything whatever pertinent to self boomed semi-elliptical sails; predetermined maximum roach parameters; or rig overlap.

IN PRACTICE, LARGE-ROACH MAINSAILS ARE INAPPROPRIATE FOR THE BOOM-CONTAINED DEVICES OF MARECHAL AND MOESSNANG

A. A. large positive mainsail roach is **contraindicated** for Marechal-Moessnang-type boom furling devices because excessive luff friction arises as roach size increases (see Amendment A, p. 32). This no doubt explains why patents for such devices avoid entirely the subject of a sail's leech curve or its roach dimensions,

B. Through patent applications, furling boom **inventors** seek patent protection. Furling boom **manufacturers** seek to insure that their booms are combined only with sails that comply to their mechanisms, **not** in patent applications, **but** in manuals for sail makers (see Amendment A, pp. 31-34). Thus have furling boom patents neatly ignored the limitations on their furling capabilities.

> "**Super-high-roach mainsails are therefore not suited for in-boom-furling.**" (Mc Geary, Cruising World, October 2000) (see Amendment A, p. 31)

C. Furling boom manufacturers set roach size limits well inside of the point at which a sail's leech might contact a permanent backstay. In fact, the limitations set by such manufacturers relate uniquely to mainsail boom

furling operation **without regard to rig overlap and certainly without regard to headsails** (see Amendment A, pp.35-39). Once again it is clear that the relevant subject matter of boom patents, whether furling or non-furling, is unrelated the subject matter of Applicant's System

D. There is no reason to suppose that furling boom prior art anticipate predetermined maximum roach overlap parameters based on initial contact between a permanent backstay and an overlapping mainsail leech.

E. Nor is it logical that furling boom prior art would have anticipated roach parameters that would **necessarily** interfere with safe, reliable furling boom operation. Stated otherwise, patents are not drawn to be self-destructing or self-effacing.

F. Finally, there is no reason to suppose that furling boom patents addressed headsails when such booms are not applicable to forestay-attached headsails. Excessive boom weight and encumbrance are but two reasons that preclude use of furling booms for headsails even before factoring in high purchase and installation costs.

G. The presence of even minimal **roach is optional** for Marechal and Moessnang. Stated otherwise, roach is not indispensable to the operation of a Marechal-Moessnang-type boom device. As such, those patents in no way made obvious **Applicant's System, which is based on the presence of a maximum area, rig-compatible elliptical roach that conforms to predetermined maximum roach parameters** (see Amendment A, pp. 34, 38, 40-42).

RIGID SPAR PATENTS DO NOT PERTAIN TO ADVANTAGEOUS USE OF FORCES GENERATED BY SAIL-TO-RIG CONTACT

1. Applicant's System **advantageously employs the energy accumulated from sail-to-rig-contact** to optimize tacking and jibing universally compatible headsails and mainsails. As concerns mainsails, any notion of using such energy to automatically enhance jibing and tacking big-roach overlapping mainsails has been inconceivable.

2. As concerns headsails, a similar use of such energy is even less conceivable than for mainsails. Nonetheless, the System introduces overlapping, self-boomed, self-tacking **Maxjibs**, which should be capable of an even more efficient use of **sail-to-mast contact than mainsails** (See Amendment A, pp. 46, 51).

3. Maxjib self-boomed headsails produce their new and unexpected results without resort to an external rigid spar. In no way did furling or non-furling boom prior art make obvious such results. In fact, overlapping, self-tacking headsails defy accepted design concepts even more than do counterpart System mainsail embodiments.

4. By definition, external rigid spar patents pertain to devices embodied by a rigid boom. Applicant's System embodiments produce their unexpected result by eliminating an external rigid spar (See Amendment A, pages 33, 42-50).

5. Bierig's condemnation of battens as inadequate for booming functions further confirms that Applicant's System is unobvious and patentable. Mr. Bierig in no way foresaw diagonal semi-rigid battens as capable of maintaining a sail's foot in horizontal tension against the force of the wind and against inward reef line forces (See Amendment A, pp. 21-22 . see also, Bierig, p. 1, lines 26-44; p. 2, lines 14-26)).

FORESEEABLE USE OF THE VAN BREEMS DEPLOYMENT CONTROL DEVICE WASLIMITED TO BOOM-MOUNTED SAILS WITH EXTERNAL HORIZONTAL BATTENS

1. The profile of the sails described and depicted in **Van Breems** are arbitrary and non-specific as concerns their roach area and leech curve. In addition, Van Breems does not pertain in any way to rig overlap.

2. Van Breems addresses <u>boom-attached sails</u> with external <u>horizontal battens</u> exclusively, and therefore is not pertinent to self-boomed mainsails or headsails with diagonal semi-rigid batten layouts. Nor is Van Breems relevant to batten reduction combinations or batten substitutes.

   > " [A Dutchman system consists of] ...one, two, or three control lines which run parallel to the mast **from the boom** to a topping lift....Equidistant...**battens run parallel to the boom**....The sail control system...**will** employ the existing boom...." (<u>Van Breems</u>, p. 1, lines 30-35 and Van Breems and Van Breems, Claim 6 at p. 4, lines 25-29).

   > "6. A sail control system as recited in Claim 2 and further comprising a plurality of vertically spaced battens **fixed to the sail** and **extending horizontally** across the sail...." (Van Breems, p. 4, lines 25-29.)

3. Van Breems' deployment control device specifically limits its applicability to boomed sails. The patent neither discloses nor infers anything about a self-boomed mainsail or headsail, let alone diagonal batten layouts (see Amendment A, p. 60).

4. Applicant's use of the patented Van Breems deployment control device is purely **optional.** Applicant's System produces its various new and unexpected results independently of a Van Breems deployment control system.

5. Applicant's use of the Van Breems deployment control device or any other deployment control device, patented or non-patented, constitutes a **new and unforeseeable use** of such devices, a use that produces new and unexpected results that go beyond the Van Breems sail stowage subject matter to enabling single-line reef configurations for unique self-boomed System sail embodiments. (See Amendment A, pages 60-63).

Applicant respectfully submits that neither Van Breems nor its prior art discloses, explicitly or implicitly, or otherwise makes obvious any of the novel properties of Applicant's System.

CONCLUSION

For all of the above reasons, Applicant submits that the specification, Drawings, and Claims of Amendment A are in proper form, and that the Claims all disclose patentably over the prior art. Therefore, Applicant submits that Amendment A is now in condition for allowance, which action Applicant respectfully requests.

Conditional Request for Constructive Assistance

Applicant has amended the Specification, Drawings, and Claims of this Application so that they are proper, definite, and define novel structure that is unobvious. If, for any reason this Application is not believed to be in full condition for allowance, Applicant respectfully requests the constructive assistance and suggestions of the Examiner pursuant to M.P.E.P. Sec. 2173.02 and Sec. 707.07 (j) in order that the undersigned can place this Application in

allowable condition as soon as possible and without the need for further proceedings.

very respectfully,

Lowell S. Fink, Applicant
787 Ch. Fontaine du Canet
Villefranche sur Mer
06230 France
Tel: 33 493017076. Cell Phone: 33 663559616

Certificate of Mailing: I certify that, on the date below, this document and referenced attachments, if any, will be deposited with Federal Express in an envelope addressed to:

"ASSISTANT COMMISSIONER FOR PATENTS, WASHINGTON, D.C. 20231.
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May 14, 2003"

Att. 3

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/781,167	02/13/2001	Lowell S. Fink		9472

7590 09/13/2002

Lowell S. Fink
PO Box 740023
Houston, TX 77274-0023

EXAMINER	
SWINEHART, EDWIN L	
ART UNIT	**PAPER NUMBER**
3617	

DATE MAILED: 09/13/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

Art Unit 3617
Lashawnah Tyson
fax - 8355 / 308 7600 /
tel 703 - 305 7687

PTO-90C (Rev. 07-01)

att. 4

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Serial No.	09/781,167
Appn. Filed:	02/13/2001
Applicant:	Lowell S. Fink
Appn. Title:	SEMI-ELLIPTICAL SAIL SYSTEM FOR WIND-PROPELLED VEHICLES
Examiner/GAU	Edwin L. Swinehart/3617

Mailed at: Villefranche sur mer 06230 France

Date: Oct. 13, 2002

Original by mail, copy by fax

CHANGE OF APPLICANT' ADDRESS

Applicant in the above-referenced application requests that his mailing address be changed to the following:

Lowell S. Fink
787 Ch. Fontaine du Canet
Villefranche-sur- mer
06230 France
telephone: 011 33 493019616
cell phone: 011 33 663559616
fax: 011 33 493019690
email: ffinklow@aol.com

1. I certify that I have transmitted this paper by fax to the Patent and Trademark Office on Oct. 13, 2002.

2. Recognizing that Internet communications are not secure, I hereby authorize the PTO to communicate with me concerning any subject matter of this application by electronic mail. I understand that a copy of these communications will be made of record in the application file.

Lowell S. Fink, Applicant

Frwd by mail - OCT. 13 '02

LH

Dec. 2, 2002

To: USPTO – attn: Mr. Edwin L. Swinehart – ART UNIT 3617
cc: Ms. Lashonnah Tyson

Re: application no. 09/781,167
a. Request for one-month extension to respond to Office Action
b. Change of address

Dear Mr. Swinehart::

This letter is to request a one-month extension for filing my response to Office Action 1 mailed 09/13/2002 and to confirm an earlier request for a change of address is in place.

a. Kindly charge my Visa card no. 4081 6100 4005 0569 issued to Lowell S. Fink, expiry date 06-04 in the amount of the one-month extension fee, which I understand is currently $55.
b. Please confirm fax or email, if possible, that my mailing address and contact information has been changed to the following:

Lowell S. Fink
787 Ch. Fontaine du Canet
Villefranche sur mer
06230 France

Tel: 011 33 493017076
Fax: 011 33 493019616
Email: ffinklow@aol.com

Thank you in advance for your assistance.
Sincerely,

Lowell S. Fink

Sent 4:06 p.m.
Dec 2, 2002
To 703-305-7687

Subj:	**Re: status of 09/781,167**
Date:	04/23/2003 18:46:37 Romance Daylight Time
From:	FFinklow
To:	Edwin.Swinehart@USPTO.GOV

Dear Mr. Swinehart:

Thank you very much for your response. When I called in to the USPTO and sent an initial one-month late fee to your attention, the person I spoke with advised me that the Examiner could allow up to six months for an initial response, and that a four-month delay beyond that was available for a maximum fee of $455. With that in mind, I have very carefully prepared my response, taking the time necessary to best resond to the comments and Objections of the First Office Action.

I did not want to ask you to extend the three-month period to a six-month period at the time I sent in an initial late fee for a one-month extension time because I felt that paying even the maximum delay fee would allow me to respond most appropriately to the First Office Action.

In fact, I received the Office Action only a month after it was issued because I was at sea doing prototype testing on my sail system until that time.I lost a month there, unfortunately, and more unfortunately, I lost another two weeks most recently as my wife underwent an emergency appendectomy, requiring most of my time. In any case, I am hoping that you can allow my Amendment and Response by according me the maximum six-month response period and addding on the necessary extension through payment of the maximum delay fee.

I have drawn my response and prepared substitute Specification, Drawings, Abstract, and Claim in compliance with the first Office Action, and I respectuflly request that you allow me to file these in the best interest of the USPTO as well as myself.

My delay in sending my response is not for want of very actively pursuing it during full working days, much of the time. I have worked constantly on my Amended Application and Response to Office Action since my return, and only today do I feel it is in final form.

I respectfully request that you allow me to file any necessary documents and pay the requisite fees as to preserve my filing date and to file my Amended Application and Response to Office Action in their present form. I preferred to take the time to fully prepare my response as opposed to sending a lesssatisfactory document earlier on, knowing I would probably have to amend it.

Since you are already familiar with my cause, and since I have already prepared an

Amendment and detailed Response to Office Action, I believe that starting an entire new proceeding would be wasteful of the resources of the USPTO as well as being prejudicial to my cause.

Thank you very much for your consideration. Sincerely,
Lowell Fink

Subj:	**status of 09/781,167**
Date:	04/23/2003 13:41:20 Romance Daylight Time
From:	*Edwin.Swinehart@USPTO.GOV*
To:	*ffinklow@aol.com*

A nonfinal office action was mailed 9/13/02 setting a 3 month period for response. In no instance may the period for response be extended beyond a total of 6 months (3/13/03). The application is currently held as Abandoned for failure to reply to the office action. A notice to this effect was mailed yesterday 4/22/03.

Ed Swinehart
703-308-2566

---------------------- Headers ---------------------------
Return-Path: <Edwin.Swinehart@USPTO.GOV>
Received: from rly-xi03.mx.aol.com (rly-xi03.mail.aol.com [172.20.116.8]) by air-xi04.mail.aol.com (v93.8) with ESMTP id MAILINXI42-21373ea67be028; Wed, 23 Apr 2003 07:41:20 -0400
Received: from mail2.uspto.gov (mail2.uspto.gov [63.71.228.71]) by rly-xi03.mx.aol.com (v93.8) with ESMTP id MAILRELAYINXI33-4d13ea67ba7c2; Wed, 23 Apr 2003 07:40:23 -0400
Received: from uspto-mta-2.uspto.gov (mailer.uspto.gov [10.96.26.47])
by mail2.uspto.gov (8.9.3 (PHNE_26304)/8.9.3) with ESMTP id HAA29420
for <ffinklow@aol.com>; Wed, 23 Apr 2003 07:40:23 -0400 (EDT)
Received: by mailer.uspto.gov with Internet Mail Service (5.5.2656.59)
id <2V7VXL6R>; Wed, 23 Apr 2003 07:40:23 -0400
Message-ID: <1C9C49B1DB59244F86DA9112947385666EF6C4@uspto-is-107.uspto.gov>
From: Edwin.Swinehart@USPTO.GOV
To: ffinklow@aol.com
Subject: status of 09/781,167
Date: Wed, 23 Apr 2003 07:40:22 -0400
MIME-Version: 1.0
X-Mailer: Internet Mail Service (5.5.2656.59)
Content-Type: text/plain;
charset="iso-8859-1"

Att. 9

Sent to: 703 [redacted] 308 7048 — oct [redacted] 10, 2002
Tel: 703-308 9726

Oct. 10, 2002
To: USPTO – expedited certified copies section
From: Lowell S. Fink
Re: two (2) EXPEDITED certified copies of:
Application no. 09/781,167
Filing Date: 02/03/2001
Confirmation No. : 9472
Inventor: Lowell S. Fink

Please send two (2) copies of the above referenced application to the following address by fedex on an expedited basis at $30 per copy and charge the copies and Fedex charges to the Visa card shown below. Please be sure to put my French phone numbers on the fedex address label. :

Send copies fedex to:
Lowell Fink
787 Ch. Fontaine du Canet
Villefranche sur mer
06239 France
Telephone before delivery: Resid:0493019616 Portable: 0663559616

Charge copies and fedex charges to my Visa card:
Lowell S. Fink
4081 6100 4005 0569
expiry 06-04

Please confirm receipt of this order to me by email at ffinklow@aol.com or by fax At 011-33-493019690. Thank you for your assistance.

Lowell S. Fink

Lowell S. Fink